Electronic Supplementary Material (ESI) for ChemComm.

SUPPORTING INFORMATION

Effect of protic additives in Cu-catalysed asymmetric Diels-Alder cycloadditions of doubly activated dienophiles: towards the synthesis of magellanine-type *Lycopodium* alkaloids

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GENERAL EXPERIMENTAL CONDITIONS

General: Unless stated otherwise, all non-aqueous reactions were performed in oven- or flame-dried glassware sealed with rubber septa under a nitrogen atmosphere, and were stirred with Teflon-coated magnetic stir bars.[1] Liquid reagents and solvents were transferred by syringe using standard Schlenk techniques. Tetrahydrofuran (THF), diethyl ether (Et_2O), toluene (PhMe), benzene (PhH), acetonitrile (MeCN), triethylamine (Et_3N) and methanol (MeOH) were dried by passage over a column of activated alumina (solvent filtration system). Dichloromethane (CH_2Cl_2) was distilled over calcium hydride under inert atmosphere. Anhydrous chloroform ($CHCl_3$) and 1,2-dichloroethane (DCE) were obtained in Sure Seal bottles from Aldrich. All other solvents and reagents were used as received unless otherwise noted. Thin layer chromatography was performed using Silicycle silica gel 60 F-254 precoated plates (0.25 mm) and visualised by UV irradiation and anisaldehyde, CAM, potassium permanganate, or iodine stain. Sorbent silica gel (particle size 40-63 μm) was used for flash chromatography of the indicated solvent system according to standard techniques.[2] Nuclear magnetic resonance (NMR) spectra (^1H, ^{13}C) were recorded on Bruker spectrometers operating at either 300, 400, 500 or 600 MHz for ^1H and 75, 100, 125, or 150 MHz for ^{13}C experiments. Chemical shifts (δ) for ^1H NMR spectra are recorded in parts per million from tetramethylsilane with the solvent resonance as the internal standard (chloroform, δ 7.26 ppm). Data are reported as follows: chemical shift, multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, qn = quintet, m = multiplet and br = broad), coupling constant in Hz, and integration. Chemical shifts for ^{13}C NMR spectra are recorded in parts per million from tetramethylsilane using the central peak of deuterochloroform (δ 77.16 ppm) as the internal standard. All spectra were obtained with complete proton decoupling. When ambiguous, proton and carbon assignments were established using COSY, HMQC and DEPT experiments. Only selected ^1H and ^{13}C spectra are reported. Infrared (IR) spectra were collected on a Perkin-Elmer Spectrum 400 FTIR instrument using attenuated total reflectance (ATR) mode and signals are reported in reciprocal centimeters (cm^{-1}). Only selected IR frequencies are reported. Low and high-resolution mass spectral data were obtained from the University of California, Berkeley Mass Spectral Facility, on a VG 70-Se Micromass spectrometer for FAB, and a VG Prospec Micromass spectrometer for EI.

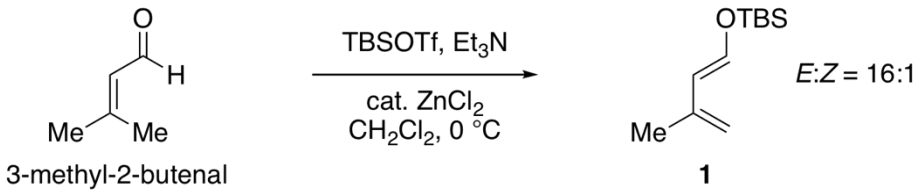
Reagents: Copper salts $Cu(OTf)_2$ and $CuCl_2$, silver salts and all chiral bis(oxazoline) ligands required for the preparation of chiral catalysts were purchased from commercial sources and used without further purification. 3-Methyl-2-butenal, TBSOTf, $ZnCl_2$, methyl 2-oxocyclopentane-1-carboxylate, PhSeSePh, Br_2, pyridine, H_2O_2•urea, KHMDS (15% in Toluene), $PhNTf_2$, 4-tributylstannylpyridine, $Pd(PPh_3)_4$, DMSO, CuCl, LiCl, DIBAL (1M in hexane), $VO(acac)_2$, TBHP (5.5M in decane), Ts_2O, DMAP, TBAF (1M in THF), Dess-Martin periodinane (DMP), K_2CO_3, $MeReO_3$, 3,5-dimethylpyrazole, $Mg(OTf)_2$, PPh_3, MoO_2Cl_2 and MeI were purchased from commercial sources and used without further purification.

[1] D. F. Shriver, M. A. Drezdzon, *The Manipulation of Air-Sensitive Compounds*; 2nd ed.; Wiley: New York, 1986.
[2] W. C. Still, M. Kahn and A. Mitra, *J. Org. Chem.*, 1978, **43**, 2923.

EXPERIMENTAL PROCEDURES AND CHARACTERISATION DATA

Specific procedures and characterisation data of diene 1 and dienophile 2

Synthesis of diene 1[3]:

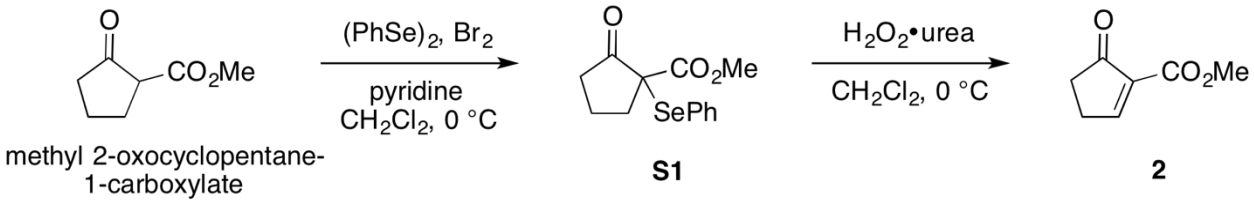


3-methyl-2-butenal **1**

A flame-dried 1 L round-bottomed flask was charged successively with freshly distilled CH_2Cl_2 (600 mL), 3-methyl-2-butenal (3.5 mL, 36.3 mmol, 1.0 equiv), dry Et_3N (7.6 mL, 54.5 mmol, 1.5 equiv) and $ZnCl_2$ (495 mg, 3.6 mmol, 0.10 equiv). The solution was cooled to 0 °C and TBSOTf (8.2 mL, 35.6 mmol, 0.98 equiv) was added dropwise. The reaction was allowed to stir at 0 °C for 5 h, at which point the reaction was quenched slowly with saturated aqueous $NaHCO_3$ (200 mL), the layers were separated and the organic layer was washed twice with saturated aqueous $NaHCO_3$ (2 x 200 mL), dried over $MgSO_4$ and concentrated. The resulting oil was rapidly purified by column chromatography (3% Et_2O/pentane), providing the (*E*)-diene **1** as a 16:1 mixture of isomers (5.08 g, 71%). An isomerically pure sample could be obtained by subsequent column chromatography purification in 100% pentane (rapid flash). $\mathbf{R_f}$ = 0.45 (100% pentane). **^{1}H NMR** (300 MHz, $CDCl_3$): δ 6.53 (d, *J* = 12.1 Hz, 1H), 5.83 (d, *J* = 12.1 Hz, 1H), 4.75 (s, 1H), 4.68 (s, 1H), 1.80 (s, 3H), 0.93 (s, 9H), 0.16 (s, 6H). **^{13}C NMR** (150 MHz, $CDCl_3$): δ 142.4, 140.0, 116.3, 111.9, 25.8 (3C), 19.2, 18.4, -5.1 (2C). **IR** (neat) 2930, 2856, 1644, 1472 cm^{-1}. **HRMS** (ESI^+) calcd for $[C_{11}H_{22}OSi+H]^+$: *m/z*, 199.1440, found 199.1467.

[3] Modified from: P. D. O'Connor, U. B. Kim and M. A. Brimble, *Eur. J. Org. Chem.*, 2009, 4405 (TMS analog).

Synthesis of dienophile 2[4]:



methyl 2-oxocyclopentane-1-carboxylate

S1

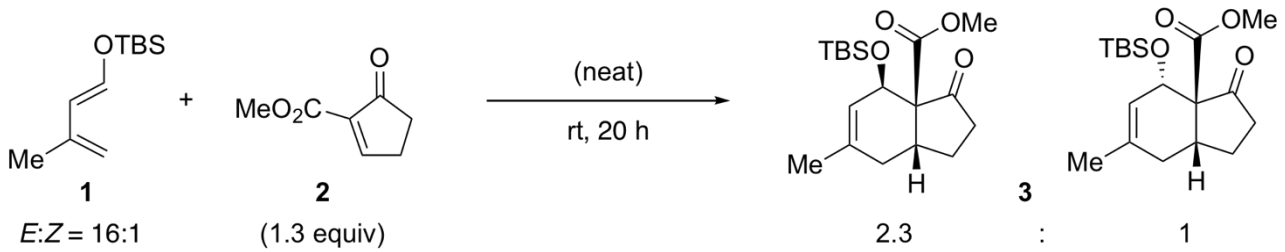
2

A flame-dried 200 mL round-bottomed flask was charged with PhSeSePh (3.02 g, 9.7 mmol, 0.60 equiv) and freshly distilled CH_2Cl_2 (65 mL). Br_2 (490 µL, 9.50 mmol, 0.59 equiv) was added dropwise at room temperature and the mixture was stirred for 35 minutes, resulting in a dark purple solution, which was cooled to 0 ˚C. Pyridine (1.95 mL, 24.2 mmol, 1.5 equiv) was added dropwise followed by methyl 2-oxocyclopentane-1-carboxylate (2.0 mL, 16.1 mmol, 1.0 equiv). The resulting solution was stirred for 1.5 h at 0 ˚C, after which time the reaction was shown to be complete by TLC analysis. The reaction mixture was poured into H_2O (100 mL) and extracted with CH_2Cl_2 (3 x 80 mL). The combined organic layers were dried over $MgSO_4$ and concentrated, affording an orange oil. The crude product was purified by column chromatography using 15-25% EtOAc in hexanes (elution gradient), furnishing pure selenide (**S1**) as a thick yellow oil (4.75 g, 99% yield) which could be kept for months in the freezer at –20 ˚C without decomposition. $\mathbf{R_f}$ = 0.17 (15% EtOAc in hexanes). All other analyses were consistent with previously reported data.[5]

A 100 mL round-bottomed flask was charged with selenide **S1** (2.53 g, 8.51 mmol, 1 equiv) and CH_2Cl_2 (43 mL). The resulting yellow solution was cooled to 0 ˚C and H_2O_2•urea (1.76 g, 18.72 mmol, 2.2 equiv) was added in one portion. The resulting heterogeneous mixture was loosely covered and vigorously stirred at 0 ˚C for 2 h, at which point TLC analysis showed disappearance of the starting material. Hexanes (40 mL) was added and the resulting mixture was stirred vigorously at 0 ˚C for 5 min, then filtered on a short pad of Celite, rinsing with hexanes (150 mL). The resulting clear colorless solution was rapidly concentrated at room temperature, affording pure dienophile **2** as a colorless oil (1.12 g, 94% yield), which was used rapidly in the subsequent Diels-Alder cycloaddition due to its instability. $\mathbf{R_f}$ = 0.11 (25% EtOAc in hexanes); **^{1}H NMR** (600 MHz, $CDCl_3$): δ 8.39 (t, *J* = 2.7 Hz, 1H), 3.78 (s, 3H), 2.73-2.69 (m, 2H), 2.53-2.50 (m, 2H). **^{13}C NMR** (150 MHz, $CDCl_3$): δ 202.9, 172.6, 162.3, 137.1, 52.0, 35.7, 26.7. All other analyses were consistent with previously reported data.[5]

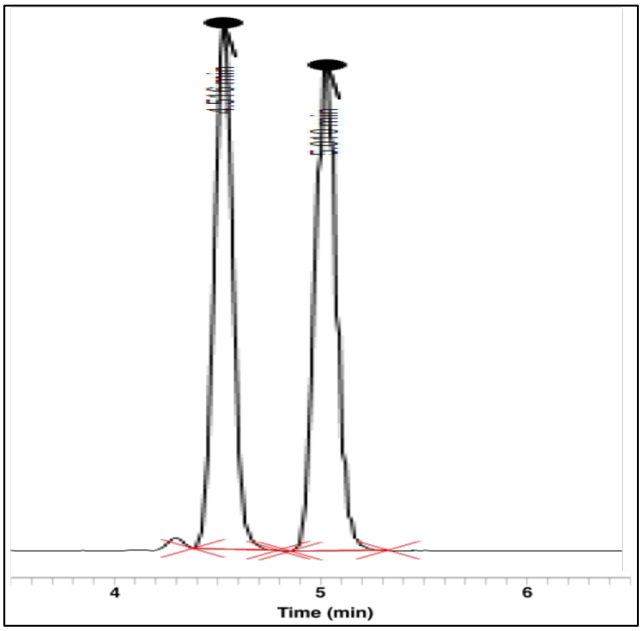
[4] Modified from: T. P. Lebold, G. M. Gallego, C. J. Marth and R. Sarpong, *Org. Lett.*, 2012, **14**, 2110.
[5] (a) S. V. Ley, P. J. Murray and B. D. Palmer, *Tetrahedron*, 1985, **41**, 4765. (b) C. Wang, X. Gu, M. S. Yu and D. P. Curran, *Tetrahedron*, 1998, **54**, 8355.

Specific procedure and characterisation data of racemic hydrindenone 3 (Scheme 1a)

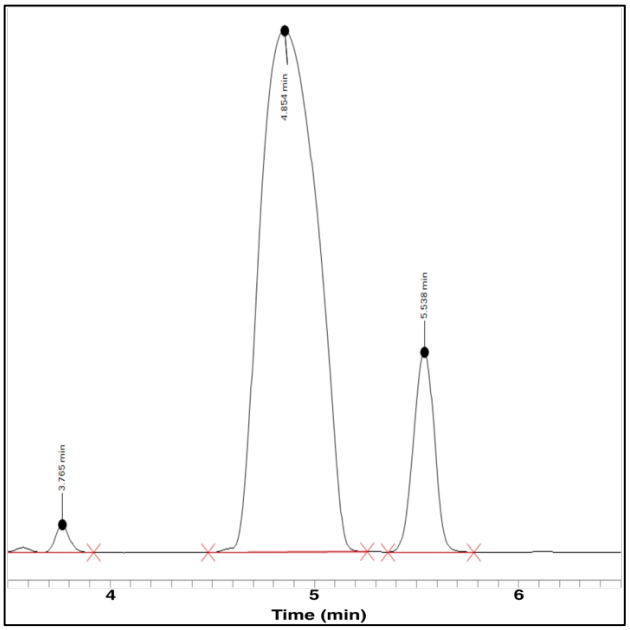


A flame-dried 25 mL round-bottomed flask was successively charged with freshly prepared dienophile **2** (3.67 g, 26.2 mmol, 1.3 equiv) and diene **1** (*E*:*Z* = 16:1, 4.00 g, 20.2 mmol, 1.0 equiv), and the colorless biphasic mixture was vigorously stirred at room temperature for 20 h. NMR analysis of the crude mixture showed full consumption of the major *E* isomer of diene **1**, while the minor *Z* isomer was unreactive under these conditions and still remained. The resulting light yellow oil was directly purified by column chromatography using 10% EtOAc in hexanes, affording hydrindenone **3** (6.09 g, 89% yield) as a colorless oil as a 2.3:1 mixture of diastereomers, favoring the ester-endo product (determined by X-Ray analysis, *vide infra*). On a 25 gram scale, 87% yield of the hydrindenone **3** was obtained with the same diastereomeric ratio. The diastereomers were readily separated by column chromatography using 4-15% EtOAc in hexanes (slow elution gradient) to afford pure samples of both isomers. $\mathbf{R_f}$ = 0.44 (major dias.), 0.48 (minor dias.) (15% EtOAc in hexanes). **^{1}H NMR** (500 MHz, $CDCl_3$): *major diastereomer*: δ 5.52-5.49 (m, 1H), 4.69 (d, *J* = 5.0 Hz, 1H), 3.69 (s, 3H), 3.27-3.13 (m, 1H), 2.52-2.37 (m, 1H), 2.32-2.22 (m, 1H), 2.19-2.08 (m, 2H), 1.66 (s, 3H), 1.64-1.55 (m, 2H), 0.80 (s, 9H), 0.02 (s, 3H), 0.01 (s, 3H); *minor diastereomer*: δ 5.55-5.50 (m, 1H), 4.85 (d, *J* = 5.0 Hz, 1H), 3.68 (s, 3H), 3.04-2.96 (m, 1H), 2.38-1.91 (m, 6H), 1.71 (s, 3H), 0.81 (s, 9H), 0.05 (s, 3H), 0.02 (s, 3H). **^{13}C NMR** (75 MHz, $CDCl_3$): *major diastereomer*: δ 211.5, 168.1, 137.6, 122.4, 67.1, 66.9, 52.7, 35.1, 33.0, 32.8, 27.3, 25.8 (3C), 23.7, 18.0, -3.7, -4.8; *minor diastereomer*: δ 213.0, 171.2, 134.9, 121.6, 66.3, 62.5, 52.7, 39.3, 37.8, 30.7, 26.9, 25.9 (3C), 24.0, 17.9, -4.2, -5.1. **IR** (neat) 2930, 2894, 1736, 1472, 1463, 1434 cm^{-1}. **HRMS** (ESI^+) calcd for $[C_{18}H_{30}O_4Si+Na]^+$: *m/z*, 361.1811, found 361.1805. For enantioenriched samples, enantiomeric excess was determined by HPLC analysis on chiral stationary phase (Phenomenex Cellulose-1 25 cm, 1% *i*-PrOH/Hexane, 1 mL/min, 217 nm, t_r (major dias.) 4.52 min, 5.01 min.

HPLC trace:

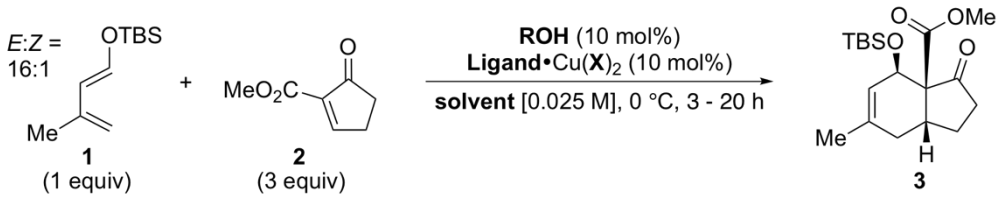


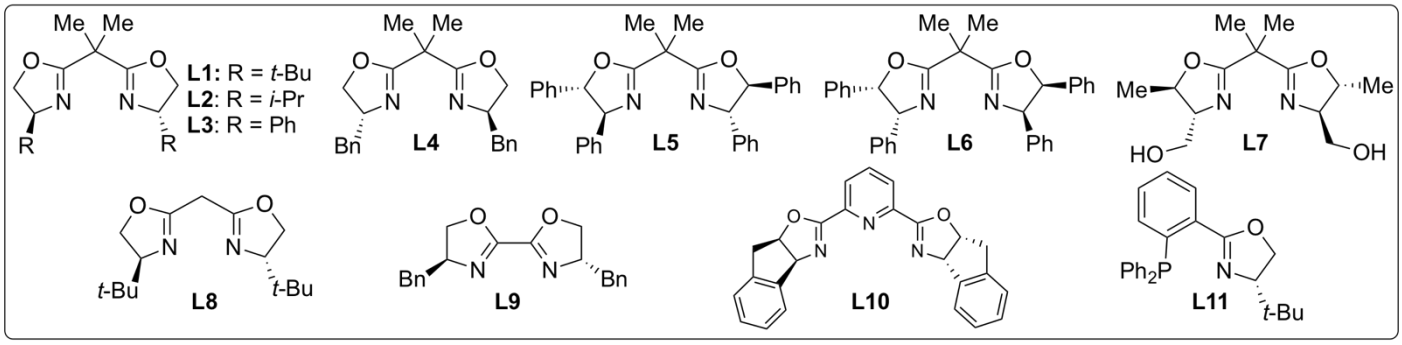
Racemic sample



86:14 er (see Table 1, entry 12)

Optimisation of the catalyst for the enantioselective variant: Effect of chiral ligand and counterion



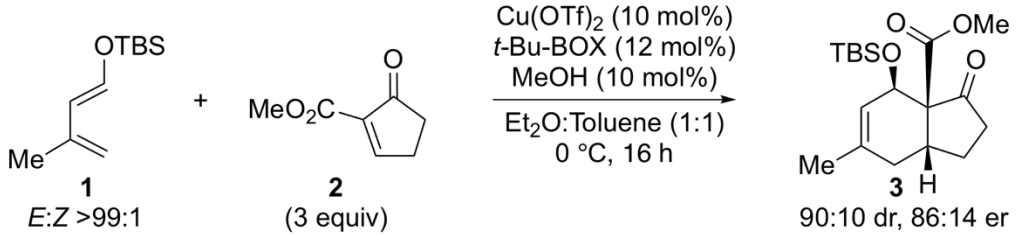


Entry	Ligand	X	ROH	Solvent	Yield[a]	dr[b]	er[c]
1	**L1**	OTf	H_2O	Et_2O	35	87:13	82:18
2	**L2**	OTf	H_2O	Et_2O	28	82:18	71:29
3	**L3**	OTf	H_2O	Et_2O	35	85:15	72:28
4	**L4**	OTf	H_2O	Et_2O	37	83:17	68:32
5	**L5**	OTf	H_2O	Et_2O	42	86:14	60:40
6	**L6**	OTf	H_2O	Et_2O	27	80:20	67:33
7	**L7**	OTf	H_2O	Et_2O	18	83:17	52:48
8	**L8**	OTf	H_2O	Et_2O	28	82:18	53:47
9	**L9**	OTf	H_2O	Et_2O	28	86:14	62:38
10	**L10**	OTf	H_2O	Et_2O	36	83:17	51:49
11	**L11**	OTf	H_2O	Et_2O	25	86:14	64:36
12	**L1**	OTf	-	CH_2Cl_2	<5	57:43	51:49
13[d]	**L1**	OTf	-	Et_2O	39	86:14	79:21
14	**L1**	OTf	MeOH	Et_2O	41	88:12	82:18
15[e]	**L1**	OTf	MeOH	Et_2O:Tol	48	89:11	83:17
16[e,f]	**L1**	**OTf**	**MeOH**	**Et_2O:Tol**	**53**	**90:10**	**86:14**
17[e,g]	**L1**	OTf	MeOH	Et_2O:Tol	49	88:12	82:18
18[g]	**L1**	SbF_6	-	Et_2O	4	nd	nd
19[g]	**L1**	SbF_6	-	CH_2Cl_2	<10	25:75	19
20[e,g]	**L1**	NTf_2	MeOH	Et_2O:Tol	47	32:68	69:31
21[e,g]	**L1**	tfa	MeOH	Et_2O:Tol	4	nd	nd
22[e,g]	**L1**	OMs	MeOH	Et_2O:Tol	4	nd	nd
23[e,g]	**L1**	BF_4	-	Et_2O:Tol	4	nd	nd
24[e,g]	**L1**	PF_6	-	Et_2O:Tol	3	nd	nd
25[e,h]	**L1**	CTf_3	MeOH	Et_2O:Tol	66	26:74	64:36
26[e,f,h]	**L1**	$O_3S(CF_2)_3CF_3$	MeOH	Et_2O:Tol	41	88:12	85:15
27[e,f,g]	**L1**	ClO_4	MeOH	Et_2O:Tol	38	65:35	74:26

[a]Determined by NMR analysis of the crude mixture using 1,3,5-trimethoxybenzene as internal standard. [b]Diastereomeric ratio determined by NMR analysis of the crude mixture. [c]Enantiomeric ratio of the major diastereomer (ester-endo product drawn) determined by HPLC using a chiral stationary phase. [d]$Cu(OTf)_2$ and *t*-BuBOX were stirred in Et_2O at rt for 16 h prior to the reaction (pre-complexation). [e]Et_2O:Toluene ratio = 1:1. [f]Pure *E* isomer (*E*:*Z* >99:1) of diene **1** was used (reaction time: 16 h). [g]Catalyst was preformed and isolated using $CuCl_2$, **L1** and the corresponding Ag salt. [h]Catalyst was formed in situ by adding 30 mol% $KCTf_3$ or $KO_3S(CF_2)_3CF_3$ to a mixture of $Cu(OTf)_2$ and **L1**.

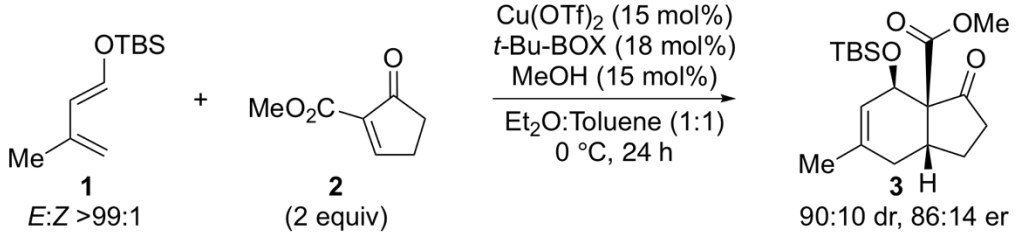
Specific procedure for the synthesis of enantioenriched hydrindenone 3

0.25 mmol scale (Table 1, entry 12):



In an inert atmosphere glove-box, a flame-dried 20 mL microwave vial was charged with $Cu(OTf)_2$ (9.0 mg, 0.025 mmol, 0.10 equiv) and *t*-Bu-BOX (8.8 mg, 0.030 mmol, 0.12 equiv), capped and taken out of the glove-box, then charged with 7 mL of dry Et_2O:Toluene (1:1) and 100 µL of a 1% v/v solution of MeOH in dry Et_2O:Toluene (1:1) (0.025 mmol, 0.10 equiv), cooled to 0 ˚C and stirred for 1 h at this temperature. To the resulting slightly green solution was added diene **1** (49.6 mg, 0.25 mmol, 1.0 equiv) in 1 mL Et_2O:Toluene (1:1), followed by freshly prepared dienophile **2** (105 mg, 0.75 mmol, 3.0 equiv) in 2 mL Et_2O:Toluene (1:1). The resulting brown solution was stirred at 0 ˚C for 16 h, affording a yellow solution which was quenched with sat. aq. NH_4Cl (3 mL) and stirred 5 minutes at 0 ˚C. 1,3,5-trimethoxybenzene (14.1 mg, 0.083 mmol) was added to determine the NMR yield. The mixture was poured into sat. aq. NH_4Cl (30 mL) and extracted with Et_2O (3 x 30 mL), dried ($MgSO_4$) and concentrated to afford a colorless oil. ^1H NMR was used at this point to determine the NMR yield (53%) and the diastereomeric ratio (90:10), and the crude mixture was then purified by column chromatography using 10% EtOAc in hexanes, affording hydrindenone **3** as a colorless oil which was analysed by HPLC using a chiral stationary phase for enantiomeric ratio determination (86:14 er, see p. S6 for HPLC trace). All other analyses were consistent with previously described data (see page S6).

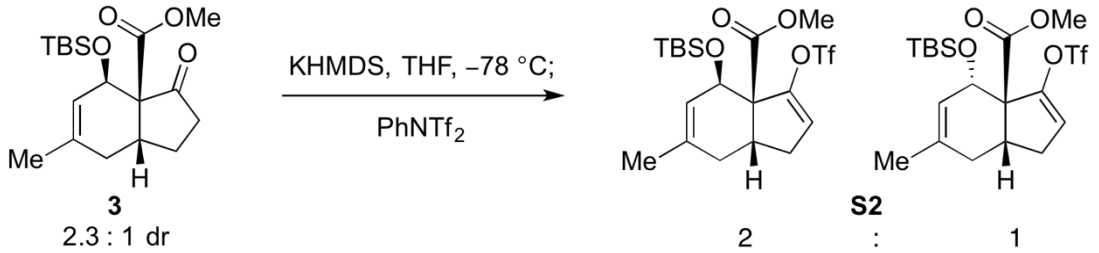
3.5 mmol scale (Scheme 2):



In an inert atmosphere glove-box, a flame-dried 250 mL round-bottomed flask was charged with $Cu(OTf)_2$ (189 mg, 0.52 mmol, 0.15 equiv) and *t*-Bu-BOX (185 mg, 0.63 mmol, 0.18 equiv), capped with a rubber septum and taken out of the glove-box, then charged with Et_2O (60 mL), Toluene (60 mL) and 2.1 mL of a 1% v/v solution of MeOH in dry Et_2O:Toluene (1:1) (0.52 mmol, 0.15 equiv), cooled to 0 ˚C and stirred for 1 h at this temperature. To the resulting slightly green solution was added diene **1** (691.1 mg, 3.48 mmol, 1.0 equiv) in 10 mL Et_2O:Toluene (1:1), followed by freshly prepared dienophile **2** (976.3 mg, 6.97 mmol, 2.0 equiv) in 10 mL Et_2O:Toluene (1:1). The resulting brown solution was stirred at 0 ˚C for 24 h, affording a yellow solution which was quenched with sat. aq. NH_4Cl (50 mL) and stirred 5 minutes at 0 ˚C. The mixture was poured into sat. aq. NH_4Cl (100 mL) and extracted with Et_2O (3 x 100 mL), dried ($MgSO_4$) and concentrated to afford a colorless oil. ^1H NMR was used at this point to determine the diastereomeric ratio (90:10), and the crude mixture was then purified by column chromatography using 10% EtOAc in hexanes, affording hydrindenone **3** as a colorless oil (595 mg, 50% yield) which was analysed by HPLC using a chiral stationary phase for enantiomeric ratio determination (86:14 er). All other analyses were consistent with previously described data (see page S6).

Specific procedures and characterisation data of pyridine 4

Synthesis of vinyl triflate intermediate S2:

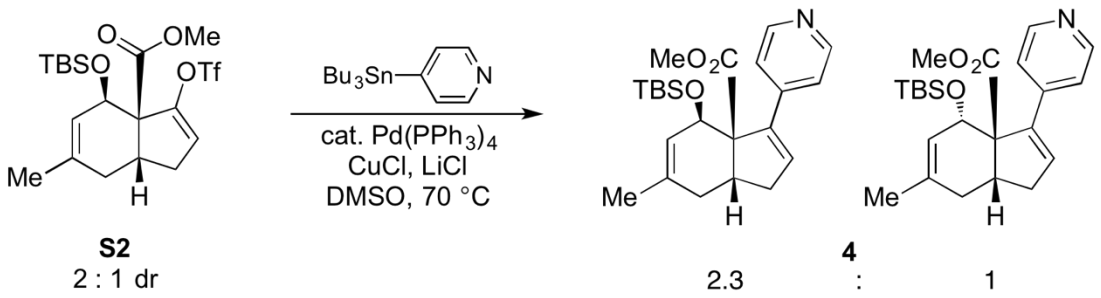


3
2.3 : 1 dr

S2
2 : 1

A flame-dried 50 mL round-bottomed flask was charged with hydrindenone **3** (2.3:1 dr, 640 mg, 1.89 mmol, 1.0 equiv) and dry THF (10 mL) and the resulting colorless solution was cooled to –78 °C. A solution of 15% KHMDS in Toluene (3.7 mL, 2.46 mmol, 1.3 equiv) was added dropwise and the resulting yellow solution was stirred at –78 °C for 1.5 h. After this time, $PhNTf_2$ (946 mg, 2.65 mmol, 1.4 equiv) in THF (3.5 mL) was added dropwise, affording an orange solution which was allowed to warm to room temperature and stirred for an additional 1.5 h, at which point TLC analysis showed complete consumption of the starting material. The reaction mixture was poured into EtOAc (250 mL) and washed with sat. aq. $NaHCO_3$ (3 x 80 mL), dried ($MgSO_4$) and concentrated under vacuum. The crude product was purified by column chromatography using 3-5% Et_2O in hexanes (slow elution gradient), affording pure vinyl triflate **S2** (838 mg, 94% yield, 2:1 dr) as a colorless oil. $\mathbf{R_f}$ = 0.77 (10% EtOAc in hexanes). **^{1}H NMR** (400 MHz, $CDCl_3$): *major diastereomer*: δ 5.69 (t, *J* = 2.6 Hz, 1H), 5.65-5.61 (m, 1H), 4.53 (d, *J* = 5.2 Hz, 1H), 3.72 (s, 3H), 3.40-3.33 (m, 1H), 2.71 (ddd, *J* = 16.8, 8.8, 2.4 Hz, 1H), 2.63-2.55 (m, 1H), 1.83 (dt, *J* = 16.9, 3.2 Hz, 1H), 1.79-1.73 (m, 1H), 1.78 (s, 3H), 0.81 (s, 9H), 0.03 (s, 3H), 0.00 (s, 3H); *minor diastereomer*: δ 5.77 (t, *J* = 2.6 Hz, 1H), 5.67-5.64 (m, 1H), 4.70 (d, *J* = 4.3 Hz, 1H), 3.73 (s, 3H), 3.08-2.99 (m, 1H), 2.62 (ddd, *J* = 15.9, 6.9, 2.8 Hz, 1H), 2.24 (dd, *J* = 15.5, 7.5 Hz, 1H), 2.08 (dd, *J* = 15.4, 5.2 Hz, 1H), 2.00 (ddd, *J* = 16.2, 5.9, 2.5 Hz, 1H), 1.75 (s, 3H), 0.84 (s, 9H), 0.03 (s, 3H), 0.03 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$): *major diastereomer*: δ 171.1, 146.2, 140.5, 123.2, 120.3, 118.5 (q, *J* = 320 Hz), 67.0, 64.1, 52.2, 35.5, 35.0, 34.5, 25.7 (3C), 24.4, 17.9, -3.9, -5.3; *minor diastereomer*: δ 173.1, 146.6, 138.0, 136.3 (q, *J* = 300 Hz), 125.1, 120.1, 68.5, 63.8, 52.6, 39.1, 35.0, 33.8, 25.7 (3C), 23.8, 18.0, -4.4, -5.3. **IR** (neat) 2955, 2930, 2857, 1743, 1424 cm^{-1}. **HRMS** (EI) calcd for $[C_{19}H_{29}F_3O_6SSi+Na]^+$: *m/z*, 493.1304, found 493.1300.

Synthesis of pyridine 4 via Stille coupling:



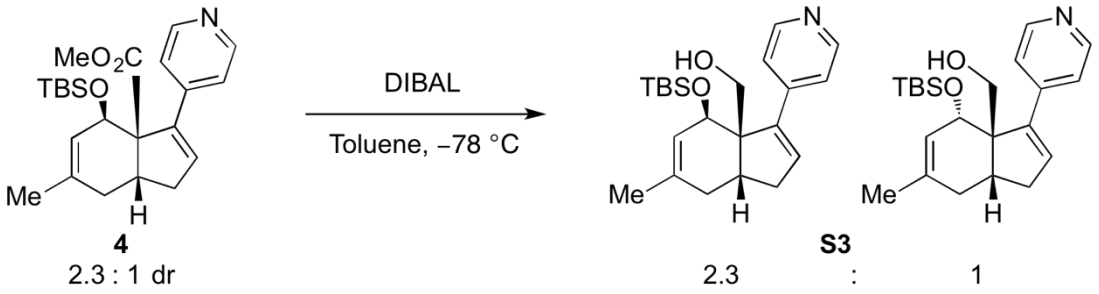
S2
2 : 1 dr

4
2.3 : 1

In an inert atmosphere glove-box, a flame-dried 100 mL round-bottomed flask was charged with $Pd(PPh_3)_4$ (189 mg, 0.163 mmol, 0.15 equiv), LiCl (277 mg, 6.53 mmol, 6 equiv) and CuCl (539 mg, 5.45 mmol, 5 equiv), capped with a rubber septum and taken out of the glove-box. Dry DMSO (23 mL) was added, followed by vinyl triflate **S2** (2:1 dr, 513 mg, 1.09 mmol, 1.0 equiv) in dry DMSO (15 mL) and 4-tributylstannylpyridine (922 mg, 2.51 mmol, 2.3 equiv) in dry DMSO (5 mL). The resulting mixture was thoroughly degassed by three freeze-pump-thaw cycles (1 h, 45 min, 30 min), stirred at rt for 1 h and then at 70 °C for 20 h under inert atmosphere. The resulting dark brown mixture was cooled to rt and poured into a mixture of 5% aq. NH_4OH (42 mL), sat. aq. NaCl (258 mL) and Et_2O (100 mL), the layers were separated and the aqueous layer was extracted with Et_2O (3 x 100 mL). The combined organic layers were dried (Na_2SO_4) and concentrated to afford the crude product, which was purified by column chromatography using 25–40% EtOAc in hexanes (slow elution gradient), affording pure pyridine **4** as a white solid (415 mg, 95% yield, 2.3:1 dr). $\mathbf{R_f}$ = 0.62 (50% EtOAc in hexanes). **^{1}H NMR** (500 MHz, $CDCl_3$): *major diastereomer*: δ 8.50 (dd, *J* = 4.7, 1.4 Hz, 2H), 7.25 (dd, *J* = 4.6, 1.6 Hz, 2H), 6.07-6.02 (m, 1H), 5.52-5.47 (m, 1H), 4.51 (d, *J* = 5.0 Hz, 1H), 3.63 (s, 3H), 3.25-3.18 (m, 1H), 2.88 (ddd, *J* = 17.0, 6.6, 2.0 Hz, 1H), 2.45 (dd, *J* = 17.4, 7.9 Hz, 1H), 2.18 (d, *J* = 6.9 Hz, 1H), 2.05 (dt, *J* = 16.9, 2.6 Hz, 1H), 1.70 (s, 3H), 0.80 (s, 9H), -0.04 (s, 3H), -0.11 (s, 3H); *minor diastereomer*: δ 8.45 (dd, *J* = 4.8, 1.5 Hz, 2H), 7.17 (dd, *J* = 4.8, 1.5 Hz, 2H), 6.51-6.47 (m, 1H), 5.83-5.78 (m, 1H), 4.85 (d, *J* = 5.4 Hz, 1H), 3.61 (s, 3H), 3.01-2.93 (m, 1H), 2.76 (ddd, *J* = 17.1, 8.8, 2.8 Hz, 1H), 2.31 (ddd, *J* = 17.1, 7.2, 2.4 Hz, 1H), 1.74 (s, 3H), 1.74-1.68 (m, 2H), 0.60 (s, 9H), -0.11 (s, 3H), -0.34 (s, 3H). **^{13}C NMR** (150 MHz, $CDCl_3$): *major diastereomer*: δ 173.4, 149.5 (2C), 145.2, 142.8, 139.7, 135.7, 123.3 (2C), 122.3, 67.5, 66.2, 51.6, 40.6, 38.1, 35.6, 25.8 (3C), 23.7, 18.1, -3.6, -4.8; *minor diastereomer*: δ 176.3, 149.8 (2C), 144.3, 141.3, 137.0, 135.6, 125.5, 120.7 (2C), 66.8, 65.0, 52.3, 43.2, 39.9, 33.4, 25.7 (3C), 23.6, 17.9, -3.8, -5.4. **IR** (neat) 2953, 2928, 2856, 1737 cm^{-1}. **HRMS** (EI) calcd for $[C_{23}H_{33}NO_3Si+H]^+$: *m/z*, 400.2230, found 400.2301.

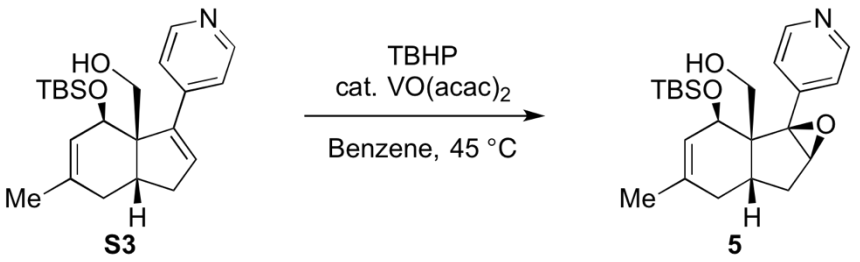
Specific procedures and characterisation data of epoxide 5

Synthesis of primary alcohol intermediate S3



A flame-dried 100 mL round-bottomed flask was charged with pyridine **4** (2.3:1 dr, 400 mg, 1.00 mmol, 1.0 equiv) and Toluene (20 mL) and the resulting colorless solution was cooled to –78 °C. A 1M solution of DIBAL in hexanes (5 mL, 5 mmol, 5 equiv) was added dropwise and the resulting solution was stirred for 35 minutes at the same temperature before being slowly quenched by addition of glacial AcOH (1.6 mL) and allowed to warm to room temperature for 10 minutes. Sat. aq. $NaHCO_3$ (50 mL) was slowly added and the biphasic mixture was transferred to a 500 mL round-bottomed flask along with CH_2Cl_2 (200 mL) and Rochelle's salt (200 mL) and stirred vigorously at rt for 15 h. The layers were separated and the aqueous layer was extracted with CH_2Cl_2 (2 x 200 mL), the combined organic layers were washed with sat. aq. NaCl (100 mL), dried (Na_2SO_4) and concentrated. The crude product was purified by column chromatography using 40–80% EtOAc in hexanes (elution gradient) to provide pure alcohol **S3** (2.3:1 dr, 357 mg, 96% yield) as a white solid. *The diastereomers were separated at this point and only the major diastereomer was carried on*. $\mathbf{R_f}$ = 0.33 (50% EtOAc in hexane). **^{1}H NMR** (500 MHz, $CDCl_3$): δ 8.50 (dd, *J* = 4.6, 1.6 Hz, 2H), 7.25 (dd, *J* = 4.6, 1.6 Hz, 2H), 6.05 (t, *J* = 2.5 Hz, 1H), 5.49-5.45 (m, 1H), 4.32-4.29 (m, 1H), 4.09 (d, *J* = 11.2 Hz, 1H), 3.76 (d, *J* = 11.2 Hz, 1H), 2.89-2.82 (m, 1H), 2.86 (s (br), 1H), 2.70 (ddd, *J* = 17.3, 8.2, 2.6 Hz, 1H), 2.41 (dd, *J* = 16.4, 6.7 Hz, 1H), 2.02 (ddd, *J* = 17.4, 5.4, 2.7 Hz, 1H), 1.87 (dd, *J* = 16.4, 4.2 Hz, 1H), 1.75 (s, 3H), 0.83 (s, 9H), 0.00 (s, 3H), -0.13 (s, 3H). **^{13}C NMR** (100 MHz, $CDCl_3$): δ 149.7 (2C), 146.0, 145.4, 138.8, 134.7, 124.7, 122.9 (2C), 71.6, 66.8, 59.4, 39.2, 38.9, 33.9, 26.0 (3C), 24.2, 18.1, -3.5, -4.9. **IR** (neat) 3319, 2928, 2856, 1599, 1471 cm^{-1}. **HRMS** (EI) calcd for $[C_{22}H_{33}NO_2Si+H]^+$: *m/z*, 372.2281, found 372.2352.

Synthesis of epoxide 5:

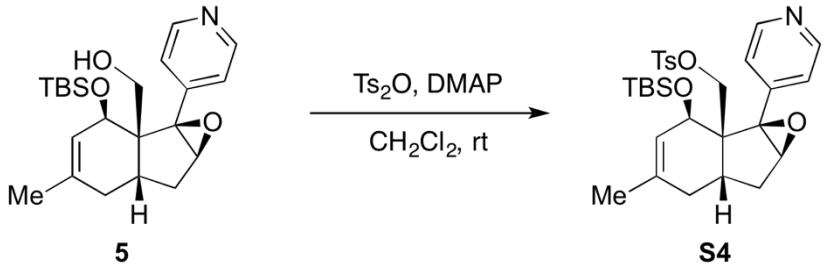


(A 1.38 M solution of TBHP in benzene/*n*-decane was prepared by addition of commercially available 5.5 M TBHP in *n*-decane (0.5 mL, 2.75 mmol) to 1.5 mL dry benzene in a flame-dried 4 mL vial.)

A flame-dried 20 mL microwave vial was charged with alcohol **S3** (300 mg, 0.807 mmol, 1.0 equiv) and dry benzene (6 mL), capped and the heterogeneous mixture was heated to 45 °C and stirred 5 minutes for dissolution, affording a colorless solution. A 13.6 mM solution of $VO(acac)_2$ in dry benzene (0.6 mL, 0.0081 mmol, 0.01 equiv) was added at 45 °C, followed by a 1.38 M solution of TBHP in benzene/*n*-decane prepared as described above (0.3 mL, 0.413 mmol, 0.51 equiv), and the resulting mixture was heated at 45 °C for 3 h. After this time, a second portion of the 1.38 M solution of TBHP in benzene/*n*-decane (0.3 mL, 0.413 mmol, 0.51 equiv) was added dropwise and the reaction mixture was held at 45 °C for another 3 h, until a final portion of the 1.38 M solution of TBHP in benzene/*n*-decane (0.3 mL, 0.413 mmol, 0.51 equiv) was added and the mixture was left heating at 45 °C for 20 h. The reaction flask was cooled to room temperature and the mixture was quenched by addition of an aqueous solution of Na_2SO_3 (207 mg Na_2SO_3 in 0.6 mL H_2O), and left stirring at room temperature for 1.5 h. The resulting mixture was diluted with EtOAc (5 mL) and poured into a mixture of sat. aq. NaCl (60 mL) and EtOAc (60 mL), the layers were separated and the aqueous layer was extracted with EtOAc (2 x 60 mL). The combined organic layers were dried (Na_2SO_4) and concentrated to afford the crude product, which was purified by column chromatography using 40–80% EtOAc in hexanes (elution gradient), affording pure epoxide **5** (248 mg, 79% yield). $\mathbf{R_f}$ = 0.29 (50% EtOAc in hexane). **^{1}H NMR** (500 MHz, $CDCl_3$): δ 8.58 (d, *J* = 4.5 Hz, 2H), 7.36 (d, *J* = 4.5 Hz, 2H), 5.44 (s, 1H), 4.48 (s, 1H), 4.11-4.05 (m, 1H), 3.98-3.92 (m, 1H), 3.53 (s, 1H), 2.65-2.58 (m, 1H), 2.49-2.33 (m, 2H), 2.14 (dd, *J* = 13.9, 7.3 Hz, 1H), 1.81 (d, *J* = 17.3 Hz, 1H), 1.74 (s, 3H), 1.62-1.54 (m, 1H), 0.64 (s, 9H), -0.01 (s, 3H), -0.32 (s, 3H). **^{13}C NMR** (125 MHz, $CDCl_3$): δ 149.7 (2C), 144.8, 136.9, 124.6 (2C), 122.6, 71.1, 70.0, 65.8, 61.7, 50.4, 37.0, 33.0, 30.3, 25.7 (3C), 24.1, 18.0, -3.1, -5.0. **IR** (neat) 3375, 2929, 2856, 1604, 1471, 1408 cm^{-1}. **HRMS** (EI) calcd for $[C_{22}H_{33}NO_3Si+H]^+$: *m/z*, 388.2230, found 388.2303.

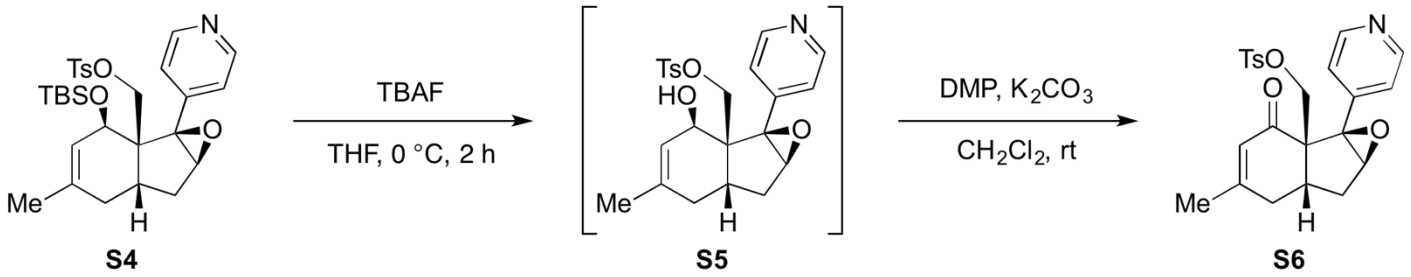
Specific procedures and characterisation data of pyridine *N*-oxide 6

Synthesis of alkyl tosylate intermediate S4:



A flame-dried 100 mL round-bottomed flask was charged with Ts_2O (791 mg, 2.42 mmol, 3.0 equiv) and dry CH_2Cl_2 (6 mL). The solution was cooled to 0 °C, a solution of DMAP (592 mg, 4.84 mmol, 6.0 equiv) in dry CH_2Cl_2 (6 mL) was added and the resulting mixture was stirred for 2 minutes at 0 °C, then warmed to room temperature and stirred for 30 min. A solution of epoxide **5** (248 mg, 0.640 mmol, 1.0 equiv) in dry CH_2Cl_2 (9 mL) was added dropwise and the resulting solution was stirred at room temperature for 17 h. The reaction mixture was poured into a mixture of sat. aq. $NaHCO_3$ (50 mL) and CH_2Cl_2 (30 mL), the layers were separated and the aqueous layer was extracted with CH_2Cl_2 (2 x 30 mL). The combined organic layers were dried (Na_2SO_4) and concentrated, and the resulting crude mixture was purified by column chromatography using 30–70% EtOAc in hexanes (elution gradient), affording pure alkyl tosylate **S4** (341 mg, 98% yield) as a white solid. $\mathbf{R_f}$ = 0.50 (50% EtOAc in hexane). **^{1}H NMR** (600 MHz, $CDCl_3$): δ 8.41 (d, *J* = 4.8 Hz, 2H), 7.85 (d, *J* = 7.9 Hz, 2H), 7.37 (d, *J* = 7.9 Hz, 2H), 7.04 (d, *J* = 4.8 Hz, 2H), 5.31 (s, 1H), 4.45 (s, 1H), 4.35 (d, *J* = 10.2 Hz, 1H), 4.22 (d, *J* = 10.2 Hz, 1H), 3.48 (s, 1H), 2.52-2.44 (m, 1H), 2.48 (s, 3H), 2.24-2.17 (m, 1H), 2.09 (dd, *J* = 13.7, 7.3 Hz, 1H), 1.75 (d, *J* = 18.3 Hz, 1H), 1.68 (s, 3H), 1.54 (t, *J* = 12.5 Hz, 1H), 0.50 (s, 9H), -0.08 (s, 3H), -0.33 (s, 3H). **^{13}C NMR** (150 MHz, $CDCl_3$): δ 149.8 (2C), 145.0, 144.1, 135.0, 133.1, 130.0 (2C), 128.3 (2C), 124.1 (2C), 122.1, 70.0, 69.2, 68.4, 59.2, 49.0, 32.5, 31.9, 28.4, 25.7 (3C), 23.6, 21.8, 18.1, -2.7, -4.5. **IR** (neat) 2955, 2928, 2856, 1601, 1366 cm^{-1}. **HRMS** (EI) calcd for $[C_{29}H_{39}NO_5SSi+H]^+$: *m/z*, 542.2318, found 542.2391.

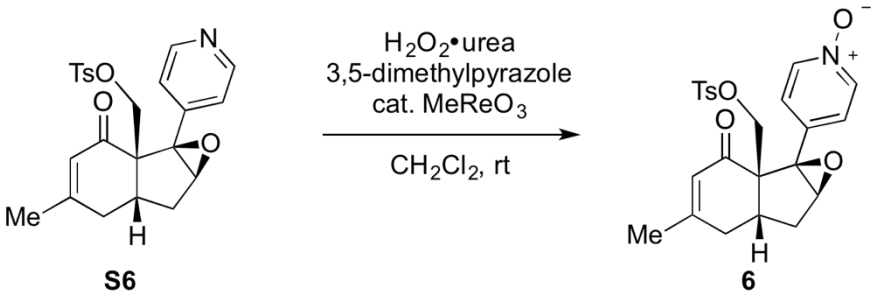
Synthesis of enone intermediate S6:



A flame-dried 50 mL round-bottomed flask was charged with alkyl tosylate **S4** (430 mg, 0.794 mmol, 1.0 equiv) and dry THF (30 mL) and cooled to 0 °C. A 1 M solution of TBAF in THF (0.87 mL, 0.873 mmol, 1.1 equiv) was added and the reaction mixture was allowed to stir at 0 °C for 2 h. At this point, the reaction mixture was loaded onto silica gel and purified by column chromatography using 5% MeOH in CH_2Cl_2 to provide allylic alcohol **S5** as an oil, which contained <10% baseline impurities and was taken on to the next step without further purification.

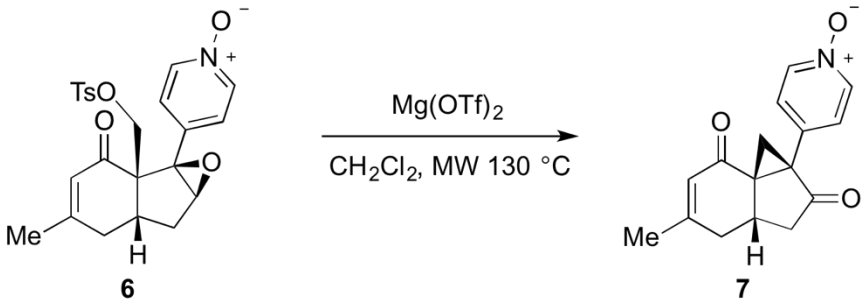
A flame-dried 100 mL round-bottomed flask was charged with crude allylic alcohol **S5** (max. 0.794 mmol, 1.0 equiv), Dess-Martin periodinane (590 mg, 1.39 mmol, 1.75 equiv), potassium carbonate (580 mg, 4.20 mmol, 5.29 equiv) and CH_2Cl_2 (40 mL). The viscous white reaction mixture was allowed to stir for 2.5 h at room temperature, at which point it was diluted with CH_2Cl_2 (50 mL) and washed with 1:1 aq. sat. $NaHCO_3$/ aq. sat. Na_2SO_3 (3 x 50 mL), and the organic layer was dried ($MgSO_4$) and concentrated. The crude product was purified by column chromatography using 1–10% MeOH in CH_2Cl_2 (elution gradient) to provide pure enone **S6** as a white solid (290 mg, 86% yield over 2 steps). $\mathbf{R_f}$ = 0.23 (5% MeOH in CH_2Cl_2). **^{1}H NMR** (600 MHz, $CDCl_3$): δ 8.49 (d, *J* = 4.9 Hz, 2H), 7.68 (d, *J* = 8.1 Hz, 2H), 7.31 (d, *J* = 8.1 Hz, 2H), 6.98 (d, *J* = 4.9 Hz, 2H), 5.93 (s, 1H), 4.41 (d, *J* = 8.9 Hz, 1H), 4.37 (d, *J* = 8.9 Hz, 1H), 3.50 (s, 1H), 2.78 (dd, *J* = 18.4, 5.9 Hz, 1H), 2.68-2.63 (m, 1H), 2.42 (s, 3H), 2.35 (dd, *J* = 14.2, 7.7 Hz, 1H), 2.19 (d, *J* = 18.5 Hz, 1H), 1.98 (s, 3H), 1.87 (dd, *J* = 14.1, 10.4 Hz, 1H). **^{13}C NMR** (150 MHz, $CDCl_3$): δ 194.1, 161.9, 149.1 (2C), 145.3, 142.9, 132.4, 130.1 (2C), 127.9 (2C), 126.6, 123.9 (2C), 73.4, 68.7, 61.9, 56.7, 36.0, 33.5, 32.2, 25.2, 21.8. **IR** (neat) 3033, 2928, 1659, 1601, 1436, 1408 cm^{-1}. **HRMS** (EI) calcd for $[C_{23}H_{23}NO_5S+H]^+$: *m/z*, 426.1297, found 426.1371.

Synthesis of pyridine *N*-oxide 6:



A 100 mL round-bottomed flask was charged with enone **S6** (290 mg, 0.682 mmol, 1.0 equiv), methyltrioxorhenium (17 mg, 0.068 mmol, 0.10 equiv), urea hydrogen peroxide (126 mg, 1.34 mmol, 2.0 equiv), 3,5-dimethylpyrazole (8.4 mg, 0.087 mmol, 0.13 equiv) and CH_2Cl_2 (25 mL). The reaction mixture was allowed to stir at room temperature for 16 h, at which point it was diluted with CH_2Cl_2 (25 mL) and washed with sat. aq. Na_2SO_3 (3 x 50 mL) and sat. aq. NaCl (50 mL). The organic layer was dried ($MgSO_4$) and concentrated, and the crude mixture was purified by column chromatography using 3–15% MeOH in CH_2Cl_2 (elution gradient) to provide pyridine *N*-oxide **6** as a white solid (235 mg, 78%). $\mathbf{R_f}$ = 0.36 (5% MeOH in CH_2Cl_2). **^{1}H NMR** (500 MHz, $CDCl_3$): δ 8.06 (d, *J* = 6.5 Hz, 2H), 7.67 (d, *J* = 8.0 Hz, 2H), 7.32 (d, *J* = 8.0 Hz, 2H), 6.99 (d, *J* = 6.5 Hz, 2H), 5.93 (s, 1H), 4.31 (s, 2H), 3.50 (s, 1H), 2.78 (dd, *J* = 18.8, 5.9 Hz, 1H), 2.69-2.60 (m, 1H), 2.45 (s, 3H), 2.35 (dd, *J* = 14.2, 7.6 Hz, 1H), 2.21 (d, *J* = 18.7 Hz, 1H), 1.99 (s, 3H), 1.85 (dd, *J* = 14.1, 10.5 Hz, 1H). **^{13}C NMR** (125 MHz, $CDCl_3$): δ 194.4, 162.5, 145.5, 138.4, 133.2, 132.2, 130.2 (2C), 127.9 (2C), 126.6 (2C), 126.4 (2C), 72.7, 67.6, 62.1, 56.5, 35.6, 33.2, 32.0, 25.2, 21.9. **IR** (neat) 3387, 2927, 1655, 1492, 1441, 1360 cm^{-1}. **HRMS** (EI) calcd for $[C_{23}H_{23}NO_6S+H]^+$: *m/z*, 442.1246, found 442.1323.

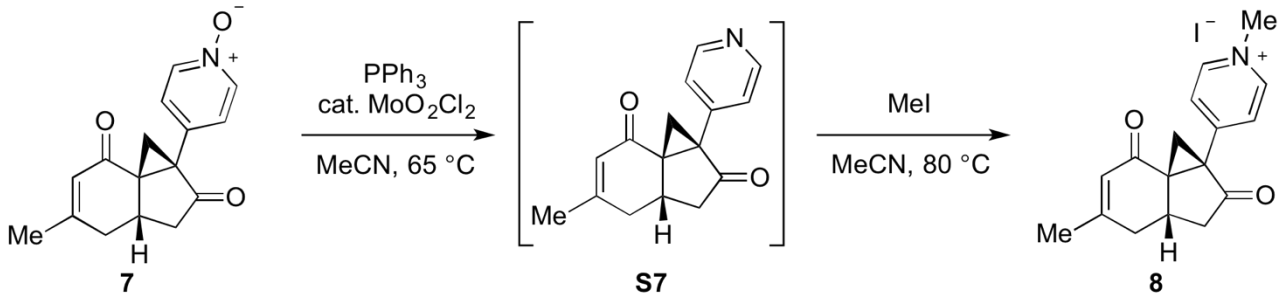
Specific procedure and characterisation data of cyclopropylketone 7



6 7

A flame-dried 20 mL microwave vial was charged with pyridine *N*-oxide **6** (36.0 mg, 0.0815 mmol, 1.0 equiv), magnesium triflate (131 mg, 0.408 mmol, 5.0 equiv) and CH_2Cl_2 (14 mL). The resulting heterogeneous mixture was heated in the microwave at 130 °C for 40 min at which point it was diluted with CH_2Cl_2 (20 mL) and washed with a solution of sat. aq. $NaHCO_3$ (3 x 10 mL) and sat. aq. NaCl (10 mL). The organic layer was dried ($MgSO_4$) and concentrated, and the resulting crude product was purified column chromatography using 3–20% MeOH in CH_2Cl_2 (elution gradient) to provide cyclopropylketone **7** (21.9 mg, >99% yield) as a beige solid. $\mathbf{R_f}$ = 0.30 (5% MeOH in CH_2Cl_2). **^{1}H NMR** (500 MHz, $CDCl_3$): δ 8.09 (d, *J* = 7.1 Hz, 2H), 7.00 (d, *J* = 7.1 Hz, 2H), 6.01 (s, 1H), 3.04 (dt, *J* = 12.4, 6.4 Hz, 1H), 2.77 (d, *J* = 5.2 Hz, 1H), 2.71 (dd, *J* = 18.3, 7.3 Hz, 1H), 2.58 (dd, *J* = 17.9, 5.8 Hz, 1H), 2.21 (dd, *J* = 17.8, 11.8 Hz, 1H), 2.16 (d, *J* = 18.3 Hz, 1H), 2.05 (s, 3H), 1.82 (d, *J* = 5.2 Hz, 1H). **^{13}C NMR** (150 MHz, $CDCl_3$): δ 207.9, 189.7, 161.4, 138.9, 130.7, 127.8 (2C), 127.6 (2C), 48.2, 46.0, 40.2, 37.2, 33.0, 25.0, 21.6. **IR** (neat) 3243, 2929, 2856, 1603, 1471 cm^{-1}. **HRMS** (EI) calcd for $[C_{16}H_{15}NO_3+H]^+$: *m/z*, 270.1052, not found.

Specific procedures and characterisation data of pyridinium salt 8

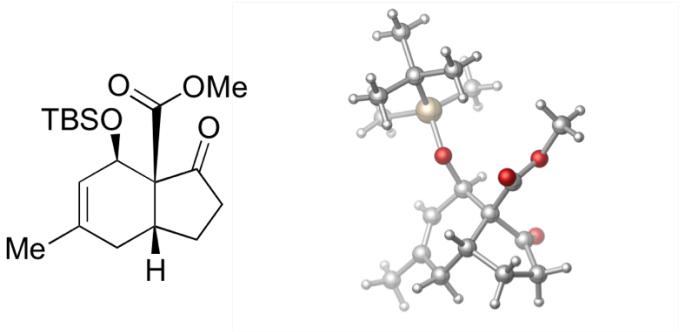


A flame-dried 25 mL round-bottomed flask was charged with cyclopropylketone **7** (47 mg, 0.175 mmol, 1.0 equiv), triphenylphosphine (51 mg, 0.193 mmol, 1.1 equiv), molybdenum chloride oxide (7 mg, 0.035 mmol, 0.20 equiv), and dry acetonitrile (10 mL). The reaction mixture was heated to 65 °C and held at this temperature for 1 h, at which point the solution was loaded onto silica gel neutralised with triethylamine and purified by column chromatography using 5% Et_2O in hexanes + 1% Et_3N. This provided pyridine **S7** along with triphenylphosphine oxide as a contaminant. This mixture was taken on to the next step without further purification.

A flame-dried 20 mL microwave vial was charged with pyridine **S7** (containing some $Ph_3P{=}O$ as contaminant, max 0.175 mmol, 1.0 equiv), iodomethane (0.11 mL, 1.75 mmol, 10 equiv), and dry acetonitrile (3 mL), the vial was sealed and heated to 80 °C for 1 h. The reaction mixture was then concentrated and purified by column chromatography on neutralised alumina using 5–10% MeOH in CH_2Cl_2 to afford pyridinium salt **8** as a red-orange solid (61 mg, 89% over 2 steps). $\mathbf{R_f}$ = 0.08 (5% MeOH in CH_2Cl_2). **^{1}H NMR** (500 MHz, $CDCl_3$): δ 9.09 (d, *J* = 6.5 Hz, 2H), 7.92 (d, *J* = 6.5 Hz, 2H), 5.97 (s, 1H), 4.55 (s, 3H), 3.11 (dt, *J* = 12.4, 6.5 Hz, 1H), 2.95 (d, *J* = 5.7 Hz, 1H), 2.85 (dd, *J* = 18.6, 7.3 Hz, 1H), 2.62 (dd, *J* = 18.2, 6.0 Hz, 1H), 2.56-2.44 (m, 1H), 2.32 (d, *J* = 18.5 Hz, 1H), 2.09 (s, 4H). **^{13}C NMR** (150 MHz, $CDCl_3$): δ 206.5, 189.1, 164.0, 152.2, 144.7 (2C), 129.8 (2C), 127.1, 50.8, 49.5, 49.0, 40.9, 37.1, 33.1, 25.4, 22.4. **IR** (neat) 3427, 2927, 1727, 1651 cm^{-1}. **HRMS** (EI) calcd for $[C_{17}H_{18}NO_2]^+$: *m/z*, 268.1332, found 268.1332.

X-RAY DATA

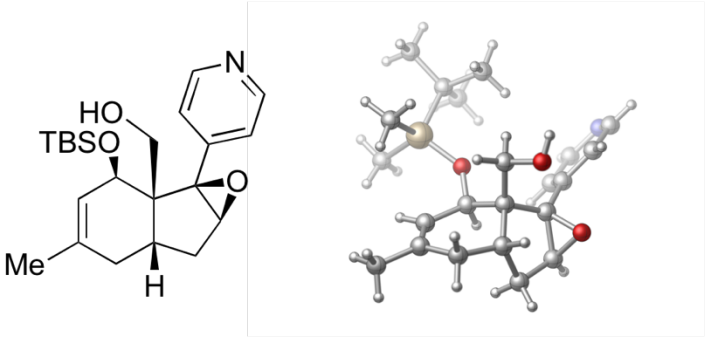
X-Ray Data of compound 3:



(crystals grown by slow evaporation of a solution of **3** in hexanes)

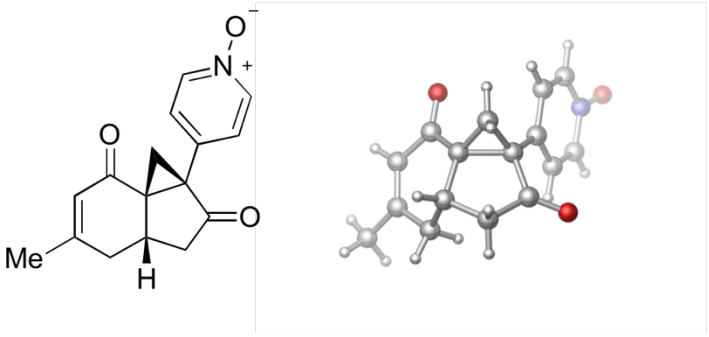
X-ray ID	sarpong43	
Sample/notebook ID	VLI-005B3	
Empirical formula	C18 H30 O4 Si	
Formula weight	338.51	
Temperature	100(2) K	
Wavelength	0.71073 Å	
Crystal system	Triclinic	
Space group	P -1	
Unit cell dimensions	a = 6.9205(7) Å	α= 81.6640(10)°.
	b = 7.0658(7) Å	β= 80.2810(10)°.
	c = 20.0779(19) Å	γ = 80.8850(10)°.
Volume	948.40(16) $Å^3$	
Z	2	
Density (calculated)	1.185 Mg/m^3	
Absorption coefficient	0.140 mm^{-1}	
F(000)	368	
Crystal size	0.200 x 0.200 x 0.200 mm^3	
Crystal color/habit	colorless prism	
Theta range for data collection	2.074 to 25.401°.	
Index ranges	-8<=h<=8, -8<=k<=8, -24<=l<=24	
Reflections collected	22218	
Independent reflections	3493 [R(int) = 0.0181]	
Completeness to theta = 25.000°	99.9 %	
Absorption correction	Semi-empirical from equivalents	
Max. and min. transmission	0.862 and 0.788	
Refinement method	Full-matrix least-squares on F^2	
Data / restraints / parameters	3493 / 0 / 215	
Goodness-of-fit on F^2	1.026	
Final R indices [I>2sigma(I)]	R1 = 0.0292, wR2 = 0.0751	
R indices (all data)	R1 = 0.0301, wR2 = 0.0760	
Extinction coefficient	n/a	
Largest diff. peak and hole	0.334 and -0.241 $e.Å^{-3}$	

X-Ray Data of compound 5:



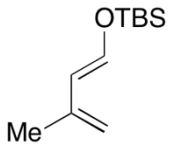
X-ray ID	sarpong59	
Sample/notebook ID	RMXII-193	
Empirical formula	C22 H33 N O3 Si	
Formula weight	387.58	
Temperature	100(2) K	
Wavelength	1.54178 Å	
Crystal system	Monoclinic	
Space group	P 21/c	
Unit cell dimensions	a = 17.6138(8) Å	α= 90°.
	b = 11.1045(5) Å	β= 93.906(2)°.
	c = 11.1829(5) Å	γ = 90°.
Volume	2182.21(17) $Å^3$	
Z	4	
Density (calculated)	1.180 Mg/m^3	
Absorption coefficient	1.110 mm^{-1}	
F(000)	840	
Crystal size	0.050 x 0.030 x 0.030 mm^3	
Crystal color/habit	colorless plate	
Theta range for data collection	2.514 to 68.247°.	
Index ranges	-21<=h<=20, -11<=k<=13, -13<=l<=13	
Reflections collected	32201	
Independent reflections	3982 [R(int) = 0.0255]	
Completeness to theta = 67.000°	100.0 %	
Absorption correction	Semi-empirical from equivalents	
Max. and min. transmission	0.929 and 0.877	
Refinement method	Full-matrix least-squares on F^2	
Data / restraints / parameters	3982 / 0 / 259	
Goodness-of-fit on F^2	1.043	
Final R indices [I>2sigma(I)]	R1 = 0.0563, wR2 = 0.1435	
R indices (all data)	R1 = 0.0631, wR2 = 0.1498	
Extinction coefficient	n/a	
Largest diff. peak and hole	0.429 and -0.404 $e.Å^{-3}$	

X-Ray Data of compound 7:



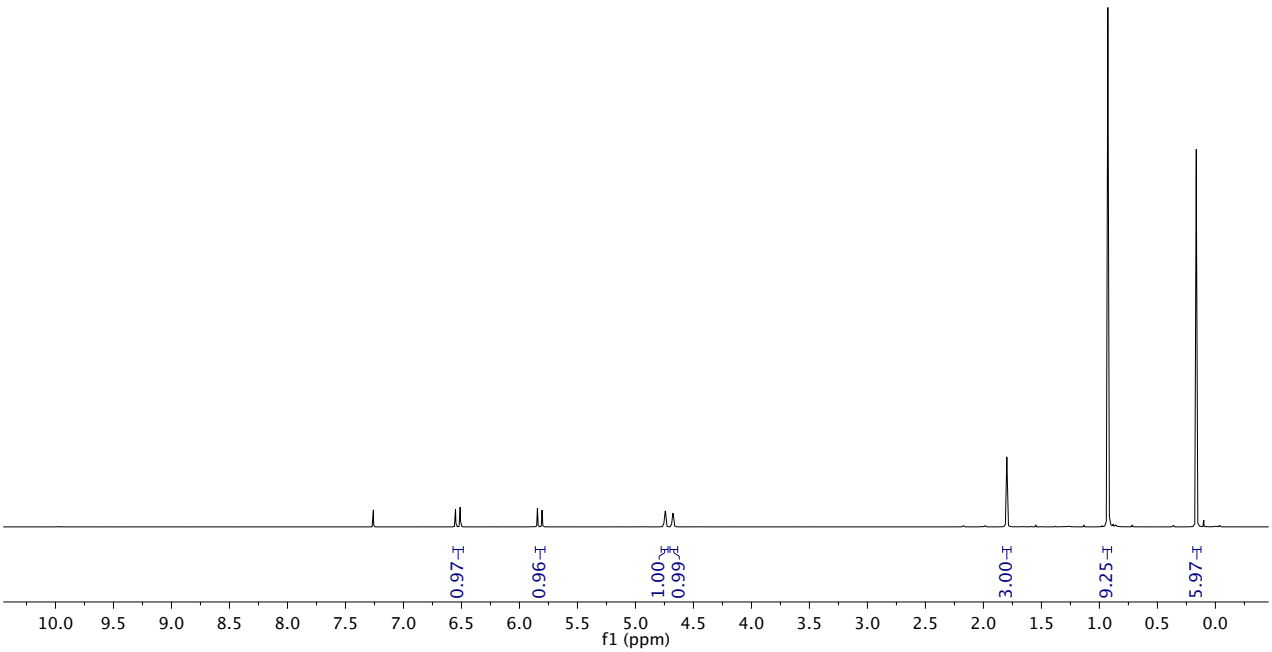
X-ray ID	sarpong62	
Sample/notebook ID	RMXIII-128B1	
Empirical formula	C16 H15 N O3	
Formula weight	269.29	
Temperature	100(2) K	
Wavelength	1.54178 Å	
Crystal system	Orthorhombic	
Space group	P 21 21 21	
Unit cell dimensions	a = 6.3718(4) Å	α= 90°.
	b = 11.6995(7) Å	β= 90°.
	c = 17.3017(10) Å	γ = 90°.
Volume	1289.79(13) $Å^3$	
Z	4	
Density (calculated)	1.387 Mg/m^3	
Absorption coefficient	0.786 mm^{-1}	
F(000)	568	
Crystal size	0.060 x 0.040 x 0.020 mm^3	
Crystal color/habit	colorless plate	
Theta range for data collection	4.562 to 68.230°.	
Index ranges	-7<=h<=7, -13<=k<=10, -20<=l<=20	
Reflections collected	15734	
Independent reflections	2352 [R(int) = 0.0153]	
Completeness to theta = 67.000°	100.0 %	
Absorption correction	Semi-empirical from equivalents	
Max. and min. transmission	0.929 and 0.880	
Refinement method	Full-matrix least-squares on F^2	
Data / restraints / parameters	2352 / 0 / 183	
Goodness-of-fit on F^2	1.114	
Final R indices [I>2sigma(I)]	R1 = 0.0307, wR2 = 0.0820	
R indices (all data)	R1 = 0.0308, wR2 = 0.0821	
Absolute structure parameter	0.5(3)	
Extinction coefficient	n/a	
Largest diff. peak and hole	0.210 and -0.132 $e.Å^{-3}$	

^{1}H and ^{13}C NMR SPECTRA

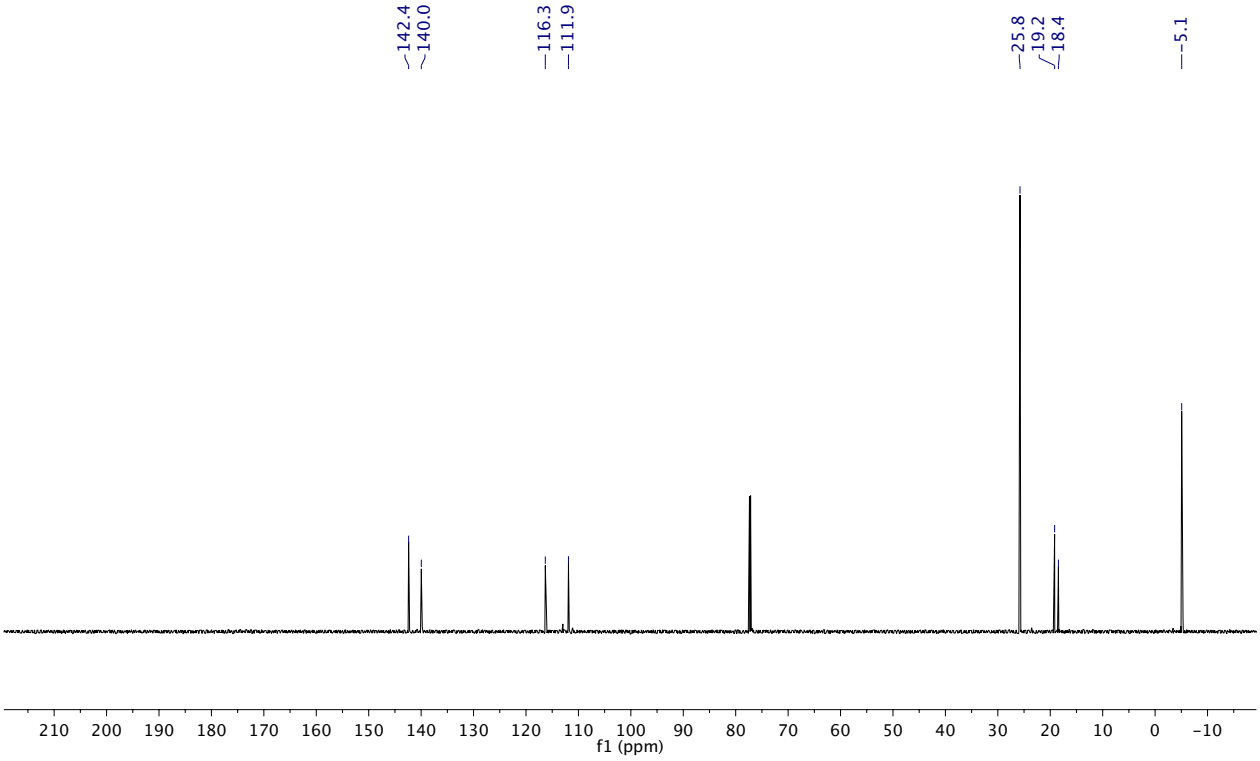


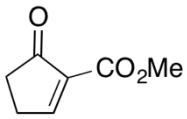
1

^{1}H NMR (300 MHz, $CDCl_3$)



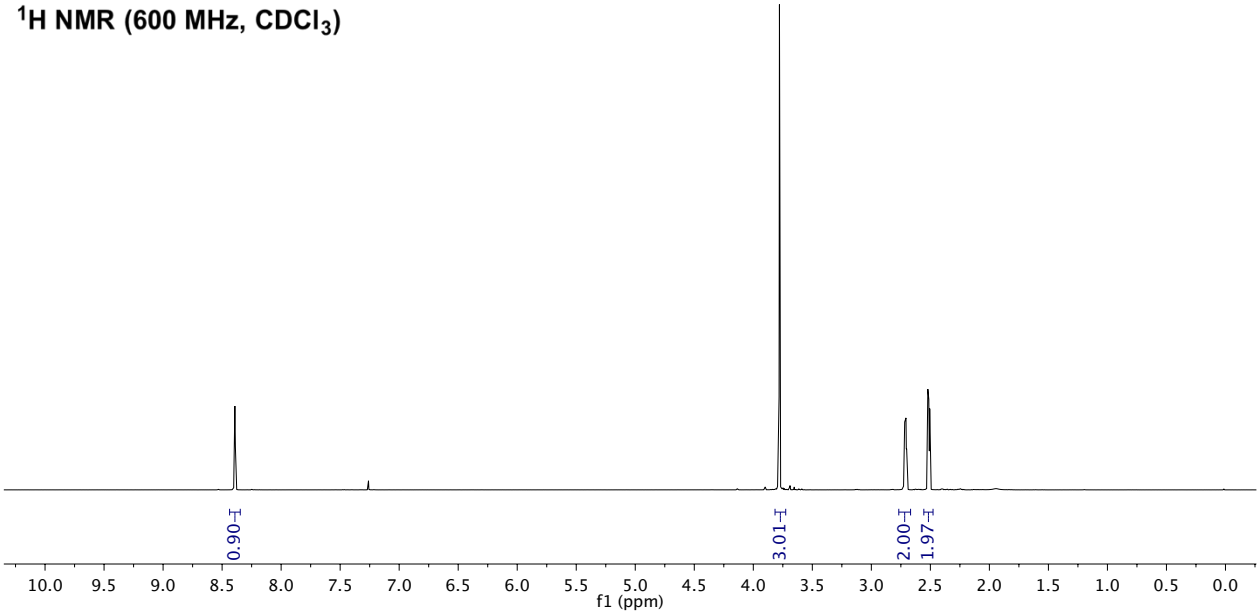
^{13}C NMR (150 MHz, $CDCl_3$)



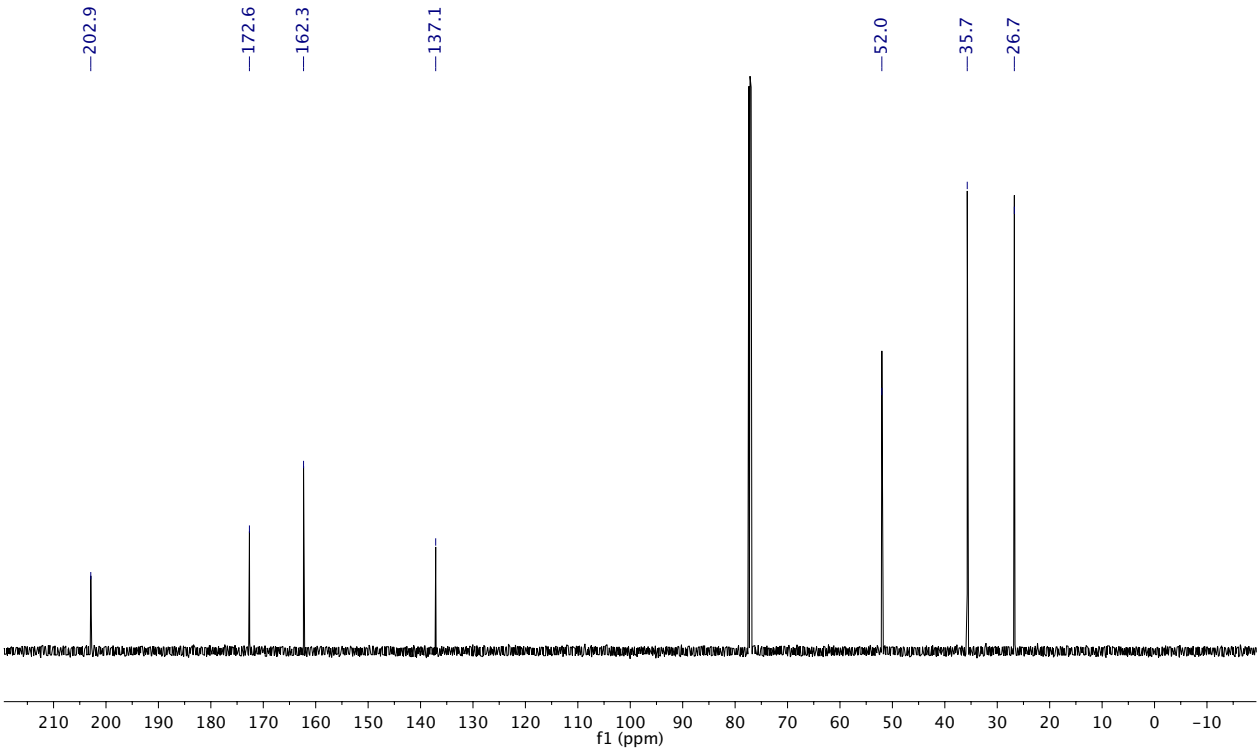


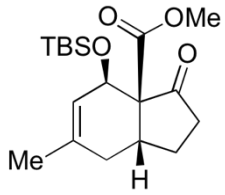
2

^{1}H NMR (600 MHz, $CDCl_3$)



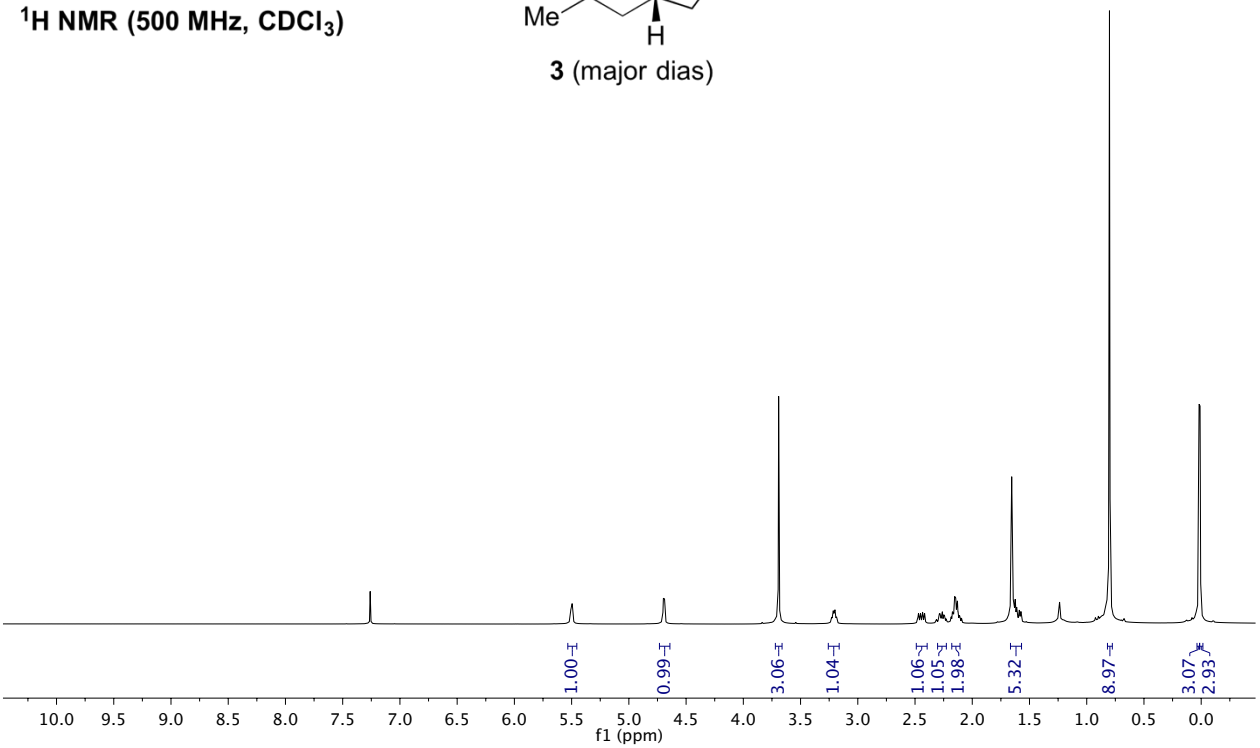
^{13}C NMR (150 MHz, $CDCl_3$)



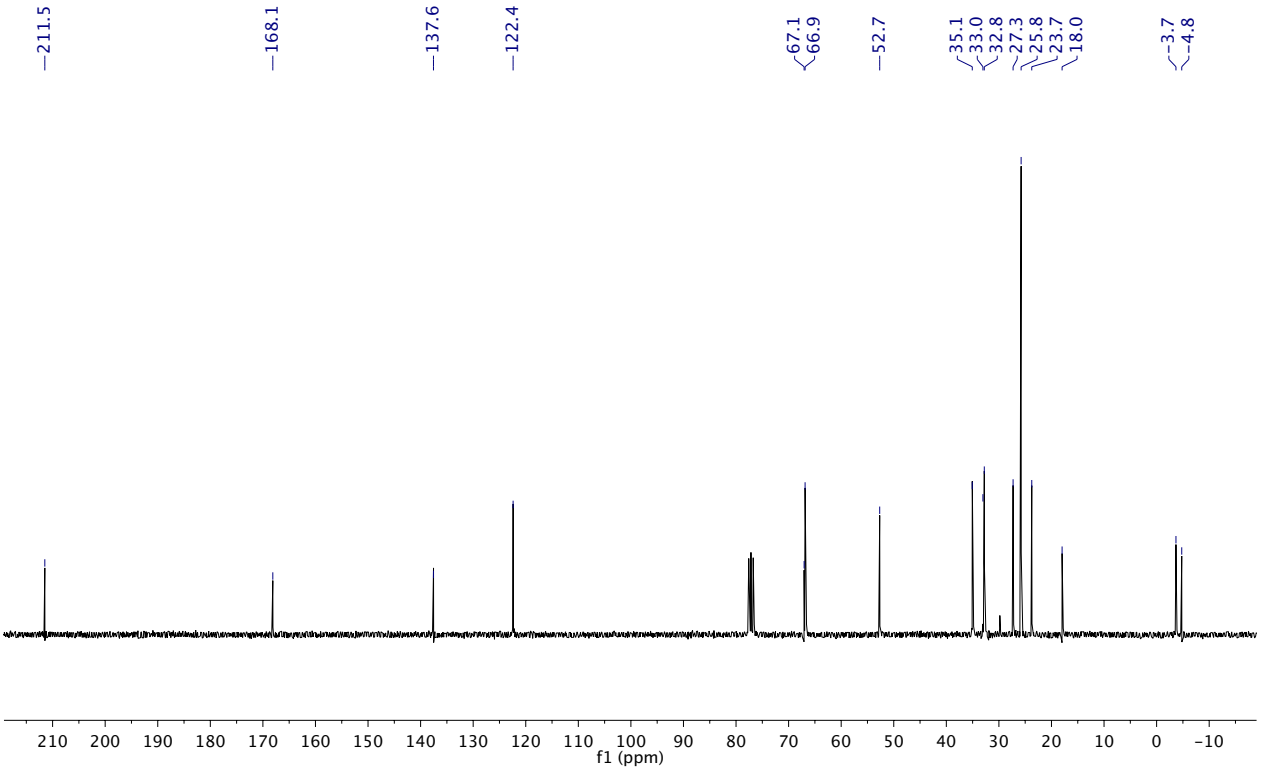


3 (major dias)

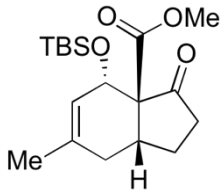
^{1}H NMR (500 MHz, $CDCl_3$)



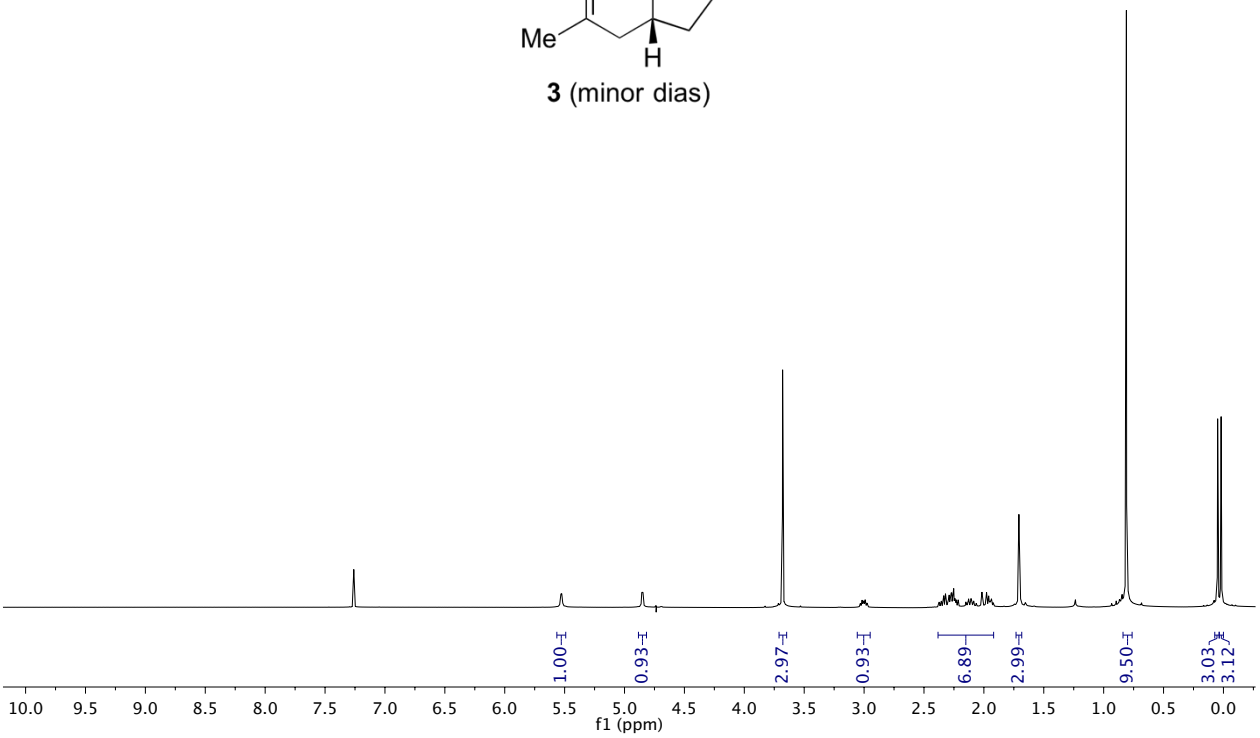
^{13}C NMR (75 MHz, $CDCl_3$)



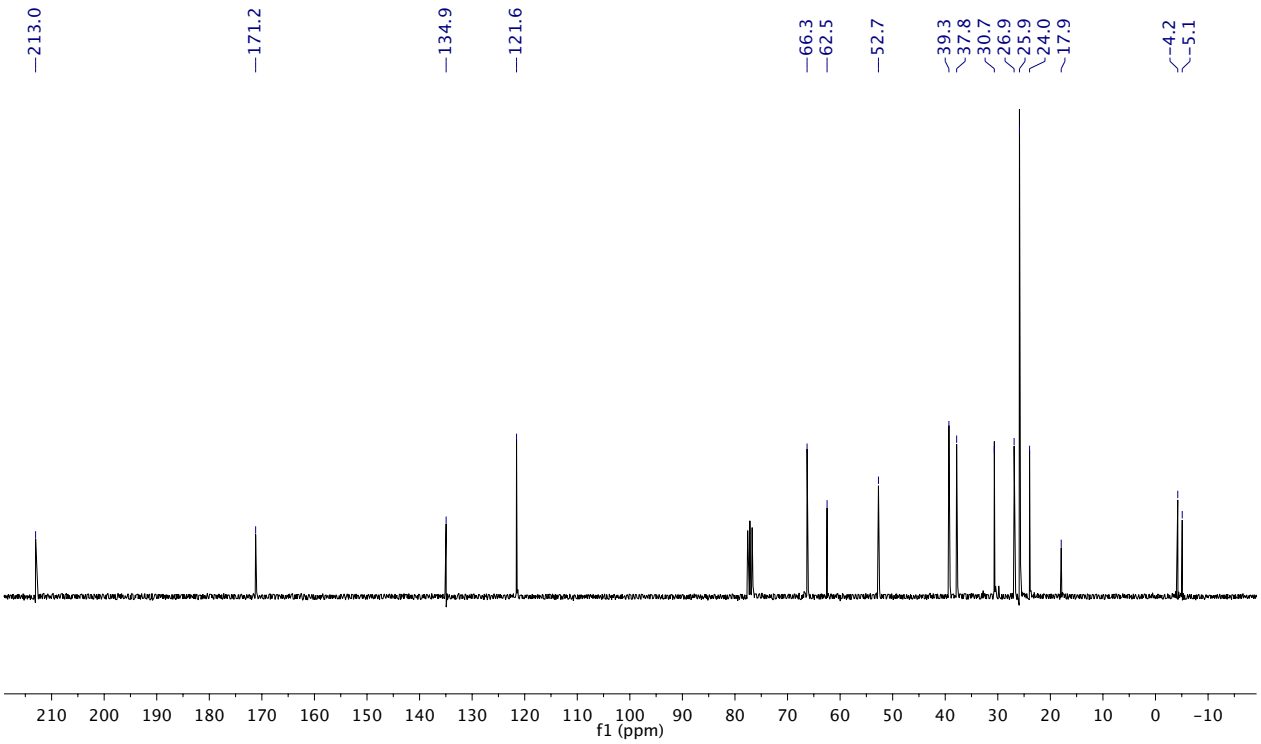
^{1}H NMR (500 MHz, $CDCl_3$)



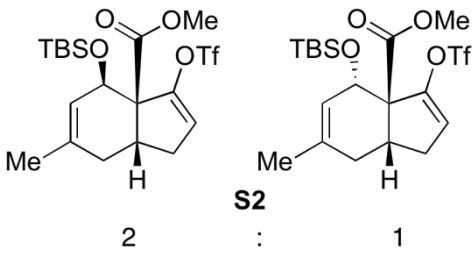
3 (minor dias)



^{13}C NMR (75 MHz, $CDCl_3$)

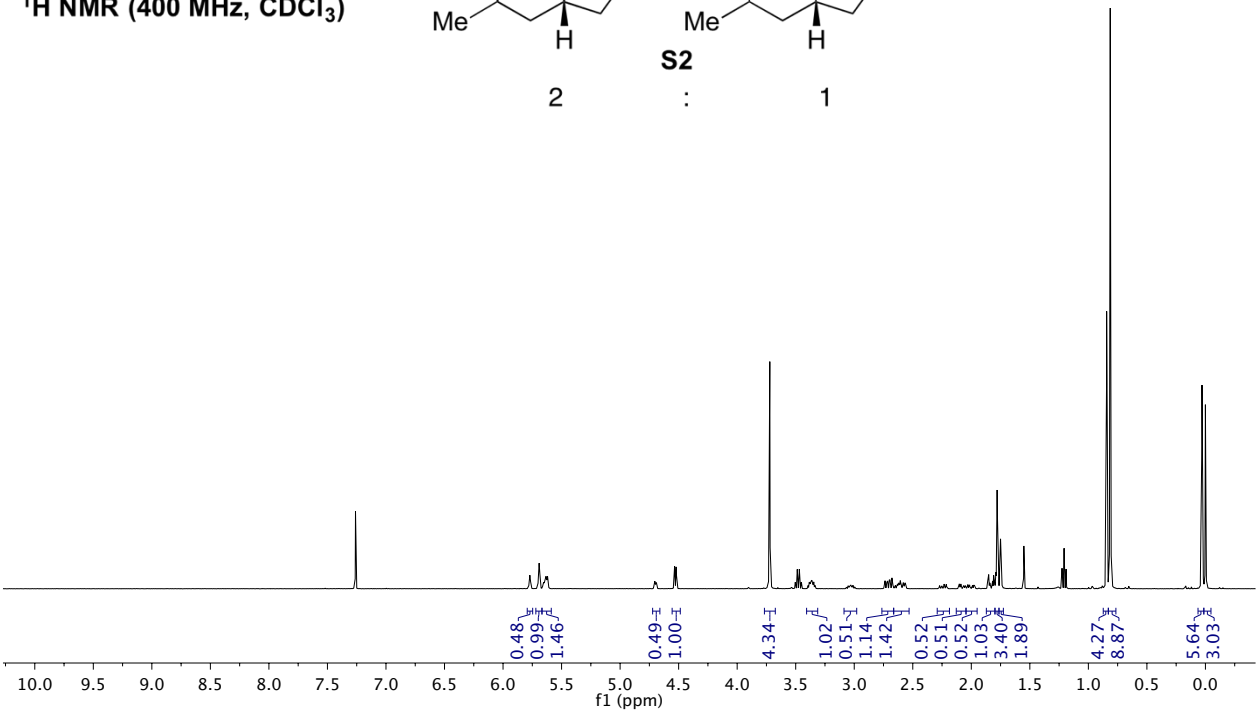


S2

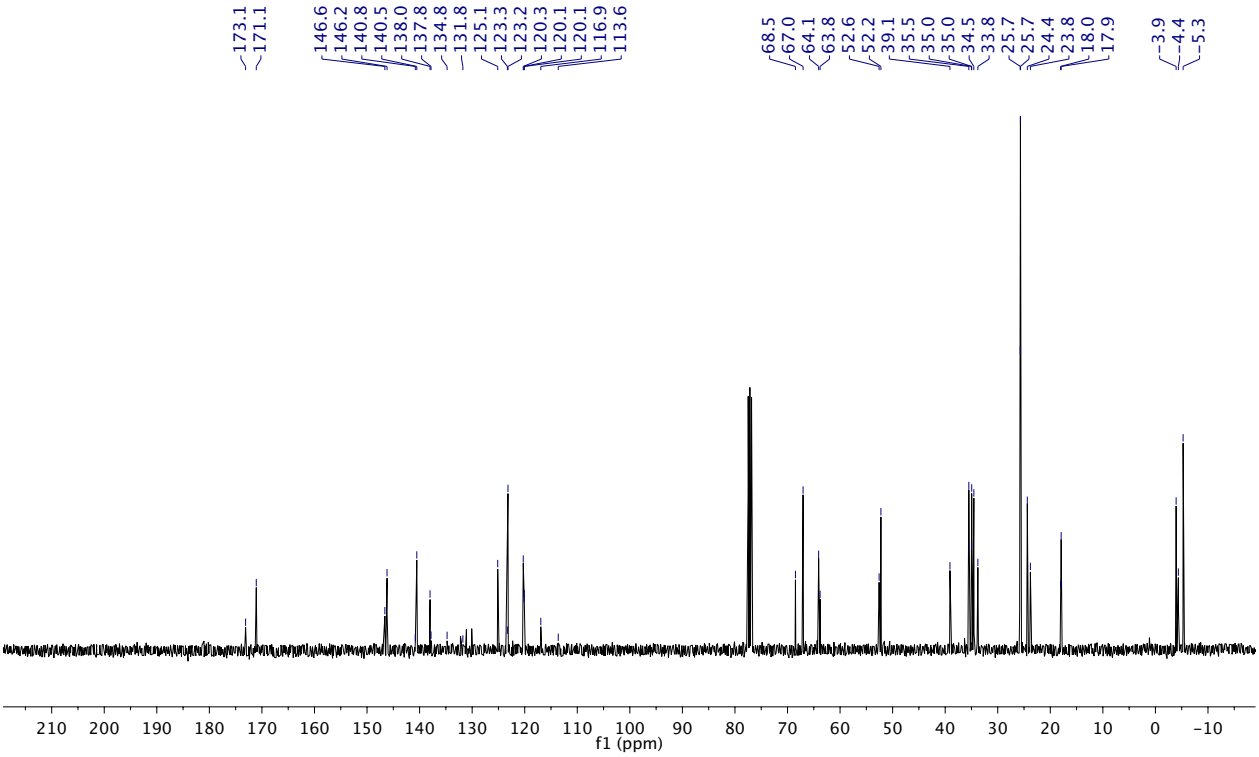


2 : 1

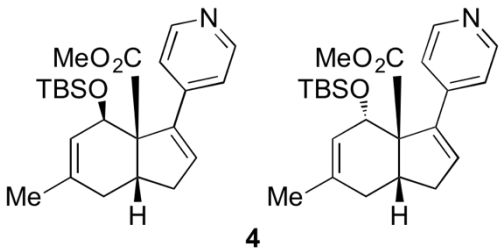
^{1}H NMR (400 MHz, $CDCl_3$)



^{13}C NMR (100 MHz, $CDCl_3$)



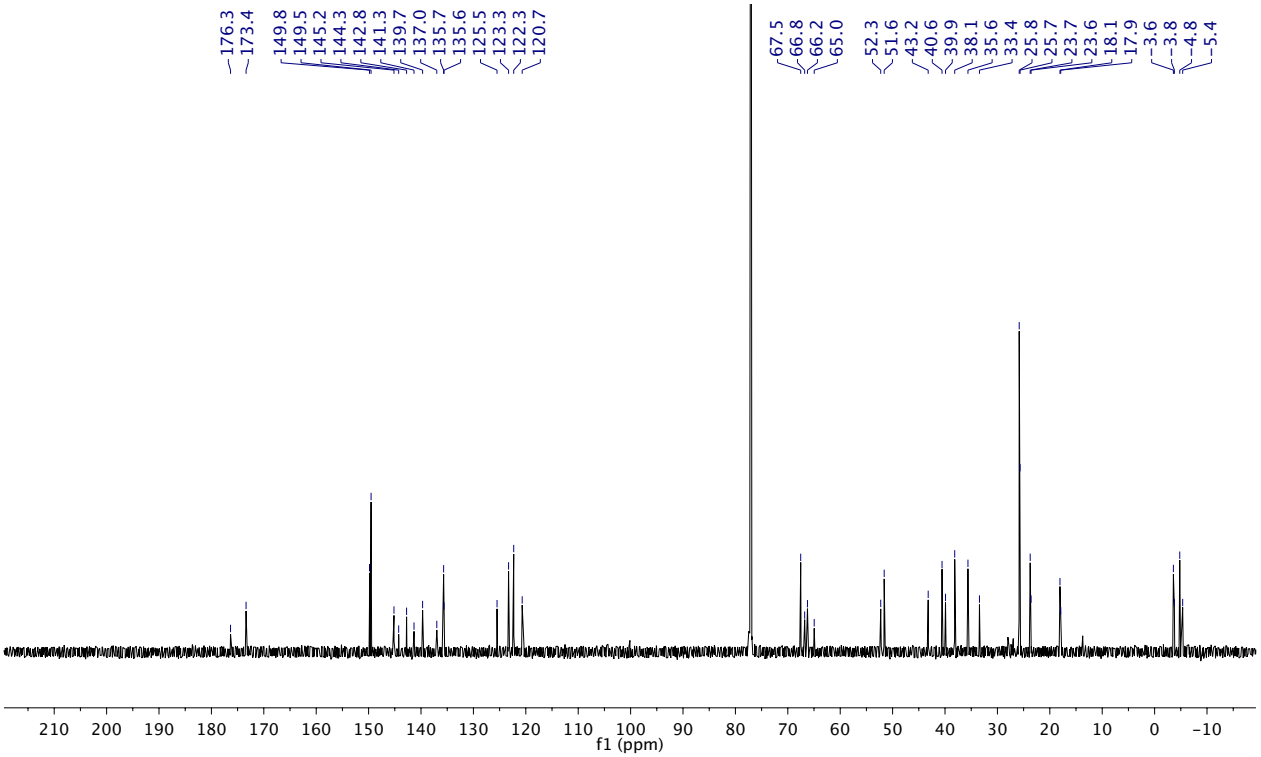
^{1}H NMR (500 MHz, $CDCl_3$)



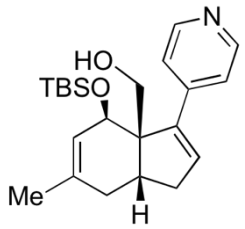
4

2.3 : 1

^{13}C NMR (150 MHz, $CDCl_3$)

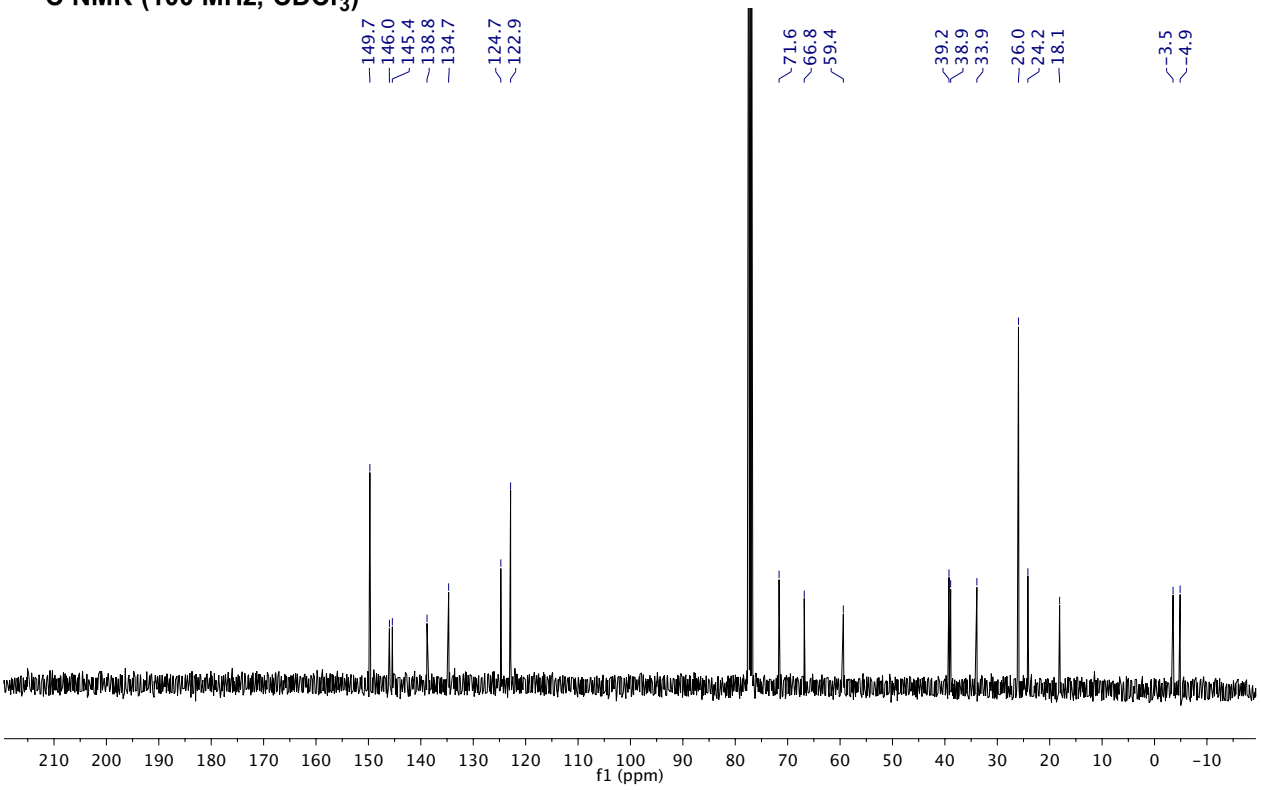


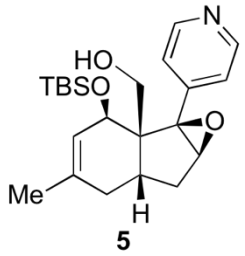
^{1}H NMR (500 MHz, $CDCl_3$)



S3

^{13}C NMR (100 MHz, $CDCl_3$)

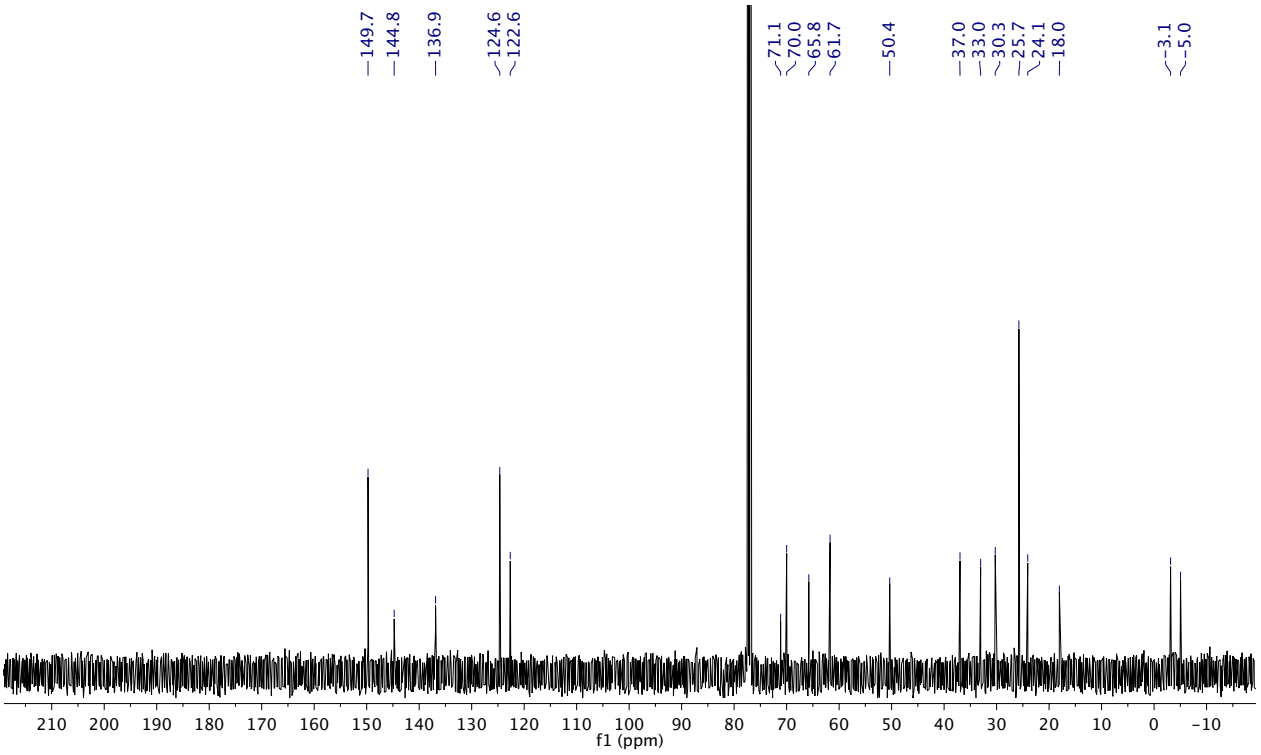




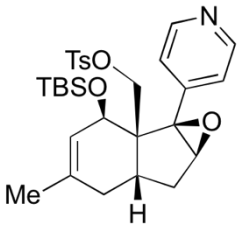
5

^{1}H NMR (500 MHz, $CDCl_3$)

^{13}C NMR (125 MHz, $CDCl_3$)

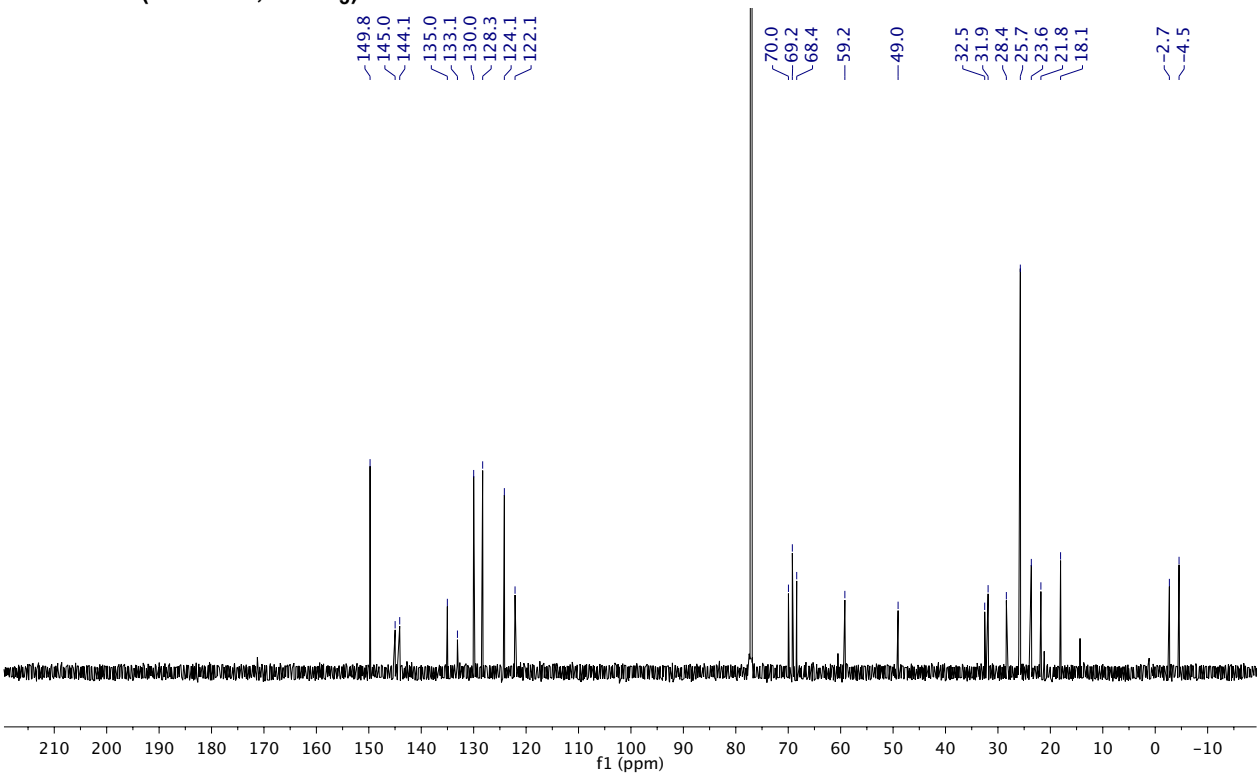


^{1}H NMR (600 MHz, $CDCl_3$)

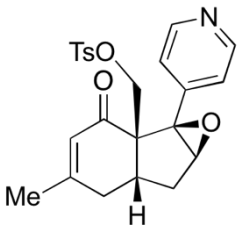


S4

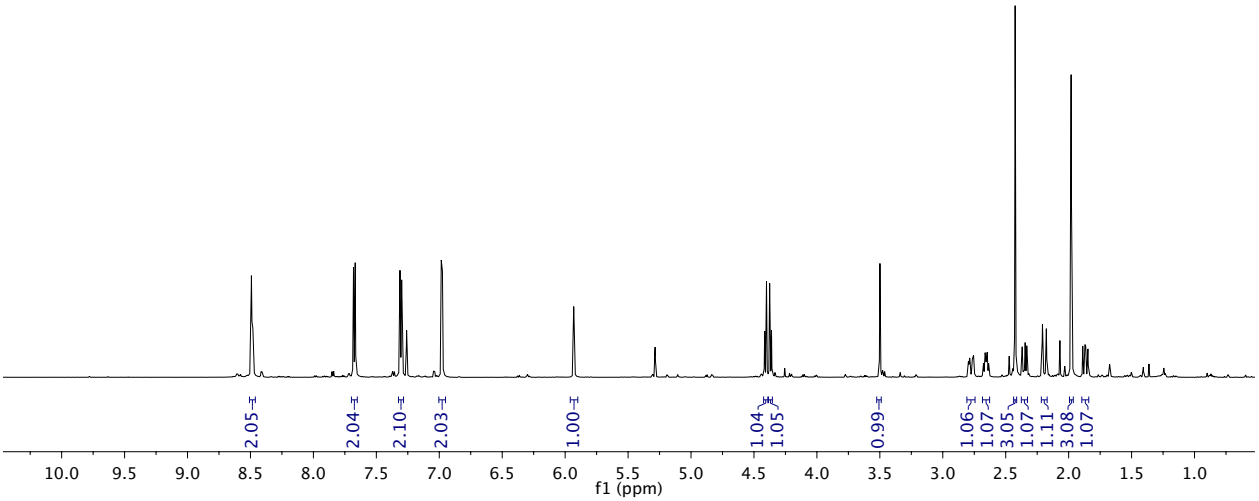
^{13}C NMR (150 MHz, $CDCl_3$)



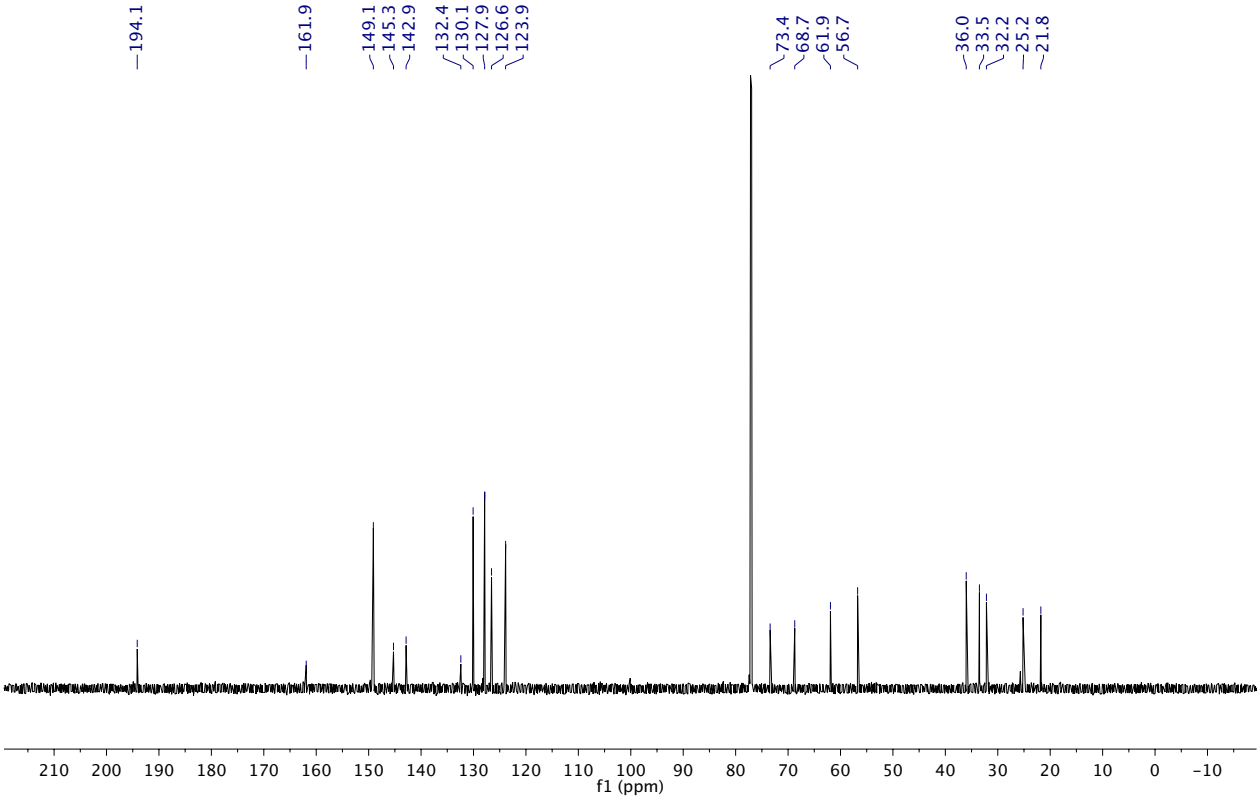
^{1}H NMR (600 MHz, $CDCl_3$)



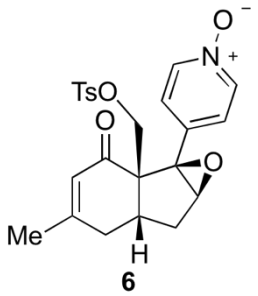
S6



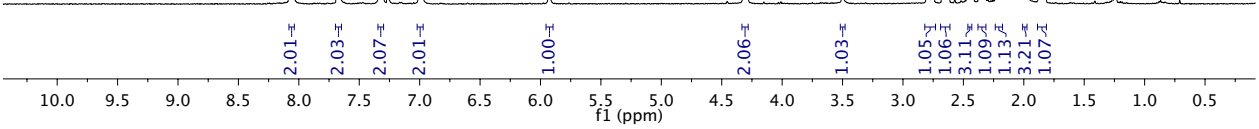
^{13}C NMR (150 MHz, $CDCl_3$)



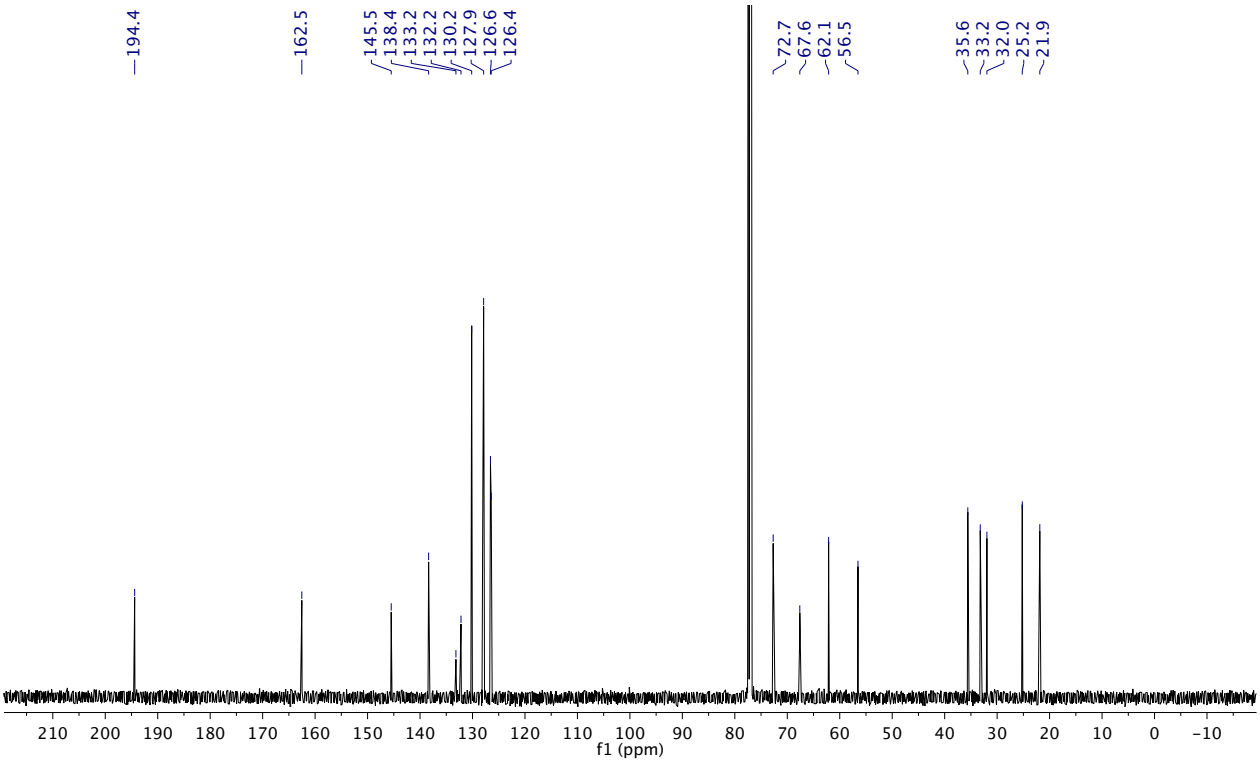
^{1}H NMR (500 MHz, $CDCl_3$)



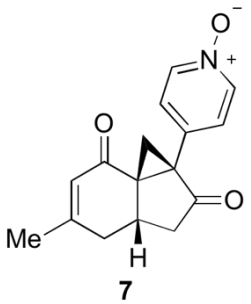
6



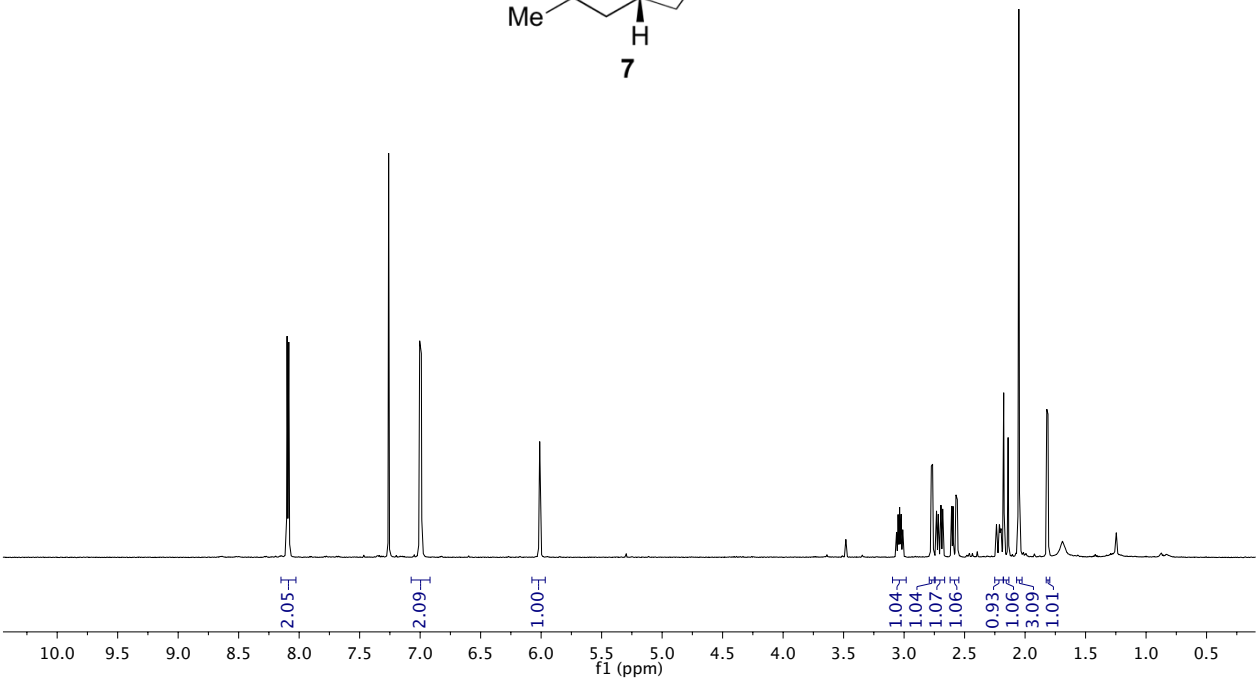
^{13}C NMR (125 MHz, $CDCl_3$)



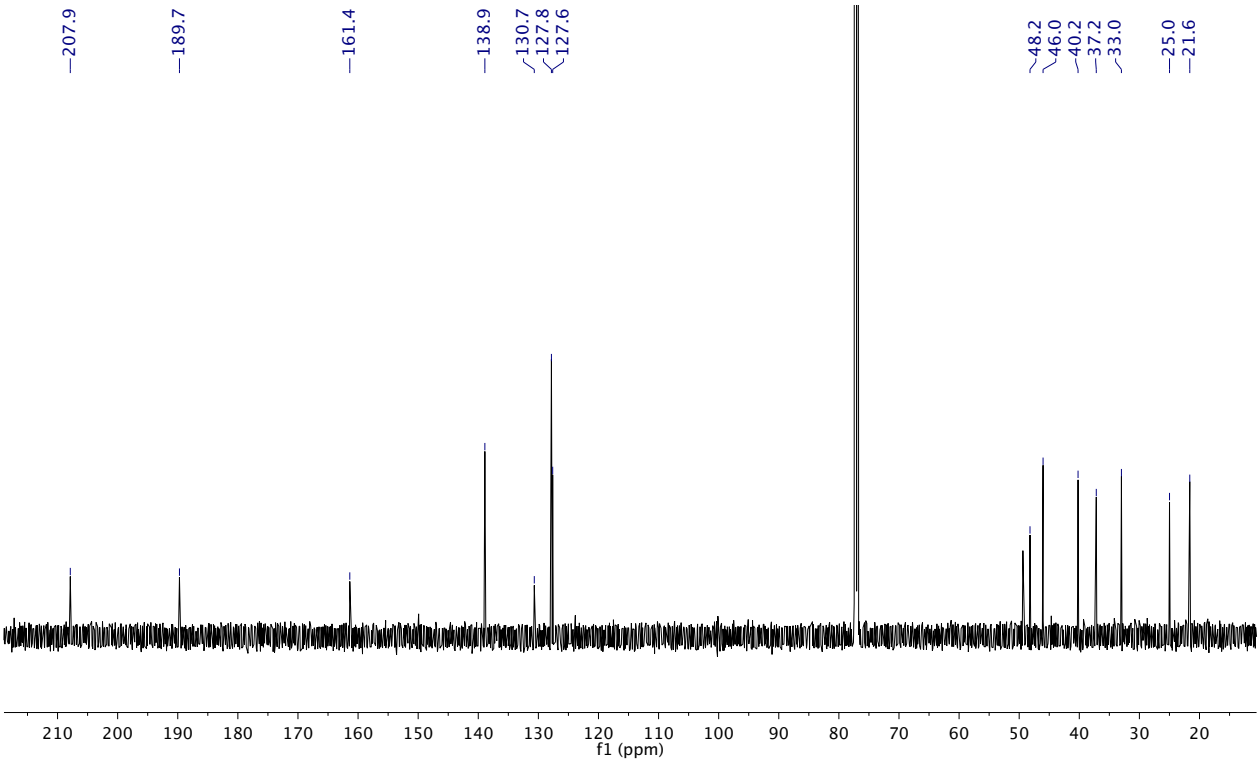
^{1}H NMR (500 MHz, $CDCl_3$)



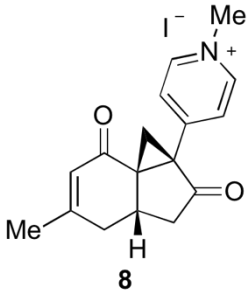
7



^{13}C NMR (150 MHz, $CDCl_3$)



^{1}H NMR (500 MHz, $CDCl_3$)



8

^{13}C NMR (150 MHz, $CDCl_3$)